

Rockefeller

(see under gold)

Saginaw (9)

(see under gold)

Shanghai (22)

(see under gold)

Short Grub

(see Beck and Short Grub under gold)

Silver Creek (11)

(see under molybdenum)

Silver Tip (10)

(see under copper)

Slate Creek

(see New Light under gold)

Tooker-Lestrud (2)

Loc: SE¼ sec. 31, (40-8E), Mt. Baker dist. **Access:** On Mt. Baker highway about 1 mi. E. of the Excelsior power house. **Prop:** 9 claims: Waldo Nos. 1 and 2, Partridge, Victory, Liberty Bell, Elnine, Robert Lee, Pay Day, Lucky Adrians. **Owner:** Vernon Lestrud and Ray Tooker, Bellingham, Wash. (1944). **Ore:** Silver. **Ore min:** Pyrite, marcasite. **Deposit:** A zone of oxidized pyrite 10 to 25 ft. or more wide. The pyrite zone is in schistose volcanic rocks and sediments. **Assays:** Spectrographic analysis showed 2.9 oz. Ag. **Ref:** 158.

Tyler

(see Veradell under gold)

Velvet

(see North American under gold)

Veradell (24)

(see under gold)

Verona (5)

(see under gold)

Whistler (23)

(see under gold)

White Swan

(see under gold)

Willis

(see Lone Jack under gold)

Yellow Aster

(see under nickel)

YAKIMA COUNTY**Bear Gap**

(see Fife under gold)

Blue Bell

(see Fife under gold)

Chinook (8)

(see under copper)

Comstock (1)

(see under gold)

Copper Mining Co. (11)

(see under copper)

Crown Point

(see under gold)

Damfino (2)

(see under gold)

Dry Spring (3)

(see under gold)

Elizabeth Gold Hill (7)

(see under gold)

Eva

(see under gold)

Fife (4)

(see under gold)

Gold Hill (5)

(see under gold)

Highland (9)

(see under gold)

Lolette (6)

(see under gold)

Manitau

(see Fife under gold)

New Find (12)

(see under copper)

Pickhandle

(see Fife under gold)

Richmond (10)

(see under lead)

SODIUM

Properties—Sodium is a silver-white metal which is lustrous when freshly cut but rapidly darkens in air. It is lighter in weight than water, ductile, malleable, and at room temperatures is nearly as soft as wax but is fairly hard and brittle at -20° C. The metal is a good conductor of heat and electricity, being exceeded in these properties only by silver, copper, gold, and possibly potassium. Weight for weight, it is three times as conductive as copper. Sodium is univalent, and its chemical properties are similar to those of potassium. Except for the silicates, almost all sodium salts are soluble in water. The metal is very reactive, oxidizing rapidly in air, and decomposing water with explosive violence; thus it must be kept in an oxygen-free environment, usually in kerosene. Other properties are shown in the table on page 12.

Uses—The softness and chemical activity of sodium make it unlikely that the metal will have much value

for the structural and mechanical uses characteristic of ordinary metals; however, the metal does have some important chemical uses. Formerly it was used as a reducing agent in producing aluminum and magnesium, and it has been considered for use in producing titanium. It now has important use as a reducing agent in making tetraethyl lead, vat-dye indigo, and in other organic syntheses. The metal has minor uses in sodium-vapor lamps, as a scavenger, to desulfurize petroleum, to dehydrate ether, and as an amalgam with mercury in platinum mining to recover platinum, which does not amalgamate with mercury alone. The metal has a low melting point, and the liquid can be used as a heat-transfer medium in power plants. Very minor use has been made of sodium alloys, but sodium salts have a great many very important industrial uses.

Production—Metallic sodium production in the United States rose from some 5,000 tons in 1929 to an estimated 8,000 to 10,000 tons in 1945. In 1950 there were two producing plants, one in Delaware and one in New York City. Washington has had a very small production of sodium salts, and in 1945 approximately 20,000 pounds of sodium metal was produced at the plant at Mead which was originally built for the production of magnesium.

Prices—In the 1880's, when sodium metal was used in the production of aluminum, it sold at about \$3.40 per pound, but later the price dropped considerably, and during World War I it was about 30 cents per pound. The price had dropped to 26¼ cents by 1921 and to 15 cents by 1929. The 1945 price was 15 cents per pound, in drums, in carload lots, and the average price for 1951 was 16½ cents, which also was the price quoted in June 1955.

Ore minerals and geology—Sodium makes up more than 2.8 percent of the earth's crust, mostly in the form

of silicates, in which it is not economically available for extraction. The solids dissolved in sea water are about two-thirds sodium chloride. Common soluble sodium minerals are halides, carbonates, and sulfates. Most sodium compounds and probably all sodium metal are made from common or rock salt, which is sodium chloride, NaCl, containing 39.4 percent sodium. Halite (the mineral name for common salt) in Washington occurs only as a mineral curiosity in infinitesimal quantity at Sulphate Lake, Grant County. Sodium carbonate and sulfate minerals found in the state are mirabilite, $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$; thenardite, Na_2SO_4 ; trona, $\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$; and natron, $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$. These are soluble salts which have accumulated by evaporation of closed-basin lakes. Some salt waters have been encountered in deep wells in the state, but none of the brines have been concentrated enough to appear to have value as a source of sodium compounds.

OCCURRENCES

Occurrences of sodium carbonate and sodium sulphate minerals are described under saline compounds in Part I of this report.

STRONTIUM

Properties—Strontium is a hard silver-white metal which quickly becomes yellow on exposure to air. It is photoelectric and reacts readily with oxygen and water. Strontium, barium, and calcium make up the group of metals known as the alkaline-earth metals. They and their compounds are very much alike chemically and physically. Strontium is always bivalent. Its salts give a brilliant crimson color to a flame. Other properties are shown in the table on page 12.

Uses—About the only use of strontium metal is in blue-green-sensitive photoelectric cells and in alloys with barium, aluminum, and magnesium which are used as "getters" to remove residual gases from evacuated electronic tubes. Strontium compounds are used for red signal flares, fireworks, and tracer bullets. Other uses are in medicines, iridescent glass, sugar refining, pigments, as a filler, and as a substitute for barite as a weighting agent in oil-well drilling mud. Strontianite has been used for desulfurizing and dephosphorizing steel.

Production—In 1950 there were reported only two domestic producers of the metal. These were in Cleveland,

Ohio, and Syracuse, New York. The Alverson strontianite-celestite deposit in western Skagit County has had intermittent small production, but no strontium metal has ever been produced in this state.

Prices—Strontium metal sold at from \$15 to \$30 per pound from 1943 to 1945. In 1949 and 1950 strontium was quoted at \$10 per pound in 500-pound lots for cast billets and \$11 per pound for extruded rods. In 1951 prices quoted were from \$7.50 to \$35 per pound, probably depending upon purity.

Ore minerals and geology—Although at least ten strontium minerals are known, the only two which are ores of the element are the sulfate, celestite, SrSO_4 , containing 56.4 percent SrO, and the carbonate, strontianite, SrCO_3 , containing 70.2 percent SrO. Celestite occurs as a gangue mineral in hydrothermal veins, as disseminated replacement deposits in limestone, as sedimentary beds, and as a chemical precipitate which may or may not be associated with saline minerals. Strontianite occurs as a secondary alteration product of celestite and as veins and nodules in limestone, marl, and shale.

OCCURRENCES

Occurrences in Washington of strontianite and celestite, the ore minerals of strontium, are described under

miscellaneous nonmetallic minerals in Part I of this report.

TANTALUM

See columbium (niobium) and tantalum on page 44.

TELLURIUM

Properties—Tellurium is a semi-metallic member of the sulfur group of elements, and like the other members of the group it is allotropic, occurring in a crystalline and an amorphous form. The amorphous form is as dark gray to brown lustrous powder, and the other form is as silver-white lustrous brittle metallic crystals. In its chemical reactions it is similar generally to sulfur and selenium. Other properties are shown in the table on page 12.

Uses—Tellurium may be substituted for selenium in many applications. Its chief use is in rubber goods, to increase tensile strength and resistance to heat and abrasion. In metallurgy it is used to improve the machining qualities of certain steels; to harden, strengthen, and add acid-resistance to lead and lead alloys; as a substitute for chromium, to produce wear-resistant surfaces on cast iron; to make special alloys of marked electrical resistance; and in making thermocouples. Added to copper and copper alloys, tellurium improves machinability without inducing hot-shortness. It is used to remove cobalt from zinc solutions prior to electrolytic deposition of zinc, and a tellurium reagent is used to produce a black finish on silverware. Tellurium is used in staining glass and china, and has restricted use in toning photographic prints and in electrical rectifiers. Of historical interest are past uses as crystal detectors in radios and as diethyl telluride in high-octane gasoline, the latter use now being taken over by tetraethyl lead.

Production—The United States output comes from four plants in Maryland, New Jersey, and Indiana. It is a by-product of lead smelting, and, with selenium, is recovered in electrolytic refining of copper. United States production of tellurium during the period 1940 to 1950 varied greatly from year to year but averaged about 100,000 pounds per year. Tellurium is not produced in Washington.

Prices—From 1920 to 1936 the price of tellurium remained at \$2 per pound or a little more, and since that time it has remained practically steady at \$1.75 per pound.

Ore minerals and geology—Most tellurium occurs as impurities in other ores, especially in chalcopyrite copper ores, but it has been found associated with selenium in solfataric deposits. Tellurium occurs sparsely in the free state associated with gold and silver, but it is usually combined with gold, silver, lead, bismuth, nickel, and copper as tellurides. It is one of the few elements that combine with gold. Secondary tellurium minerals are the oxide and a few rare tellurates or tellurites. Some of the better known tellurides are sylvanite, $(\text{Au,Ag})\text{Te}_2$, containing 58 to 62 percent tellurium; petzite, $(\text{Au,Ag})_3\text{Te}_4$, containing 32 to 35 percent tellurium; calaverite, AuTe_2 , containing 56 to 58 percent tellurium; and tetradyte, Bi_2Te_3 , containing 39 to 49 percent tellurium.

OCCURRENCES

The map showing the numbered tellurium occurrences is plate 18, on page 47 in volume 2.

FERRY COUNTY

Ada

(see Laura S. under lead)

Grandview (3)

(see under lead)

Knob Hill (1)

(see under gold)

Laura S. (4)

(see under lead)

Morning Glory (2)

(see under gold)

Old Gold

(see Morning Glory under gold)

OKANOGAN COUNTY

Bellevue (2)

(see under gold)

Calumet (1)

(see under gold)

Wolverine (3)

(see under gold)

TEVENS COUNTY

Beecher (1)

(see under gold)

WHATCOM COUNTY

Anacortes (5)

(see under gold)

Bonita

(see New Light under gold)

Boundary Gold

(see Lone Jack under gold)

Brooks-Willis

(see Lone Jack under gold)

Eureka

(see New Light under gold)

Great Excelsior (1)

(see under gold)

Lambert

(see Lone Jack under gold)

Lincoln

(see Great Excelsior under gold)

Lone Jack (2)

(see under gold)

Lone Star (3)

(see under gold)

Mammoth (6)

(see under gold)

Monica

(see New Light under gold)

Mount Baker

(see Lone Jack under gold)

New Light (7)
(see under gold)

Ninety-nine (8)
(see under gold)

Post-Lambert
(see Lone Jack under gold)

President
(see Great Excelsior under gold)

Slate Creek
(see New Light under gold)

Tacoma (9)
(see under gold)

Terra Alta (4)
(see under gold)

Willis
(see Lone Jack under gold)

THORIUM

Properties—Thorium is a soft heavy gray metal which is malleable and difficultly fusible. It is strongly radioactive, emitting alpha, beta, and gamma rays. It is very resistant to chemical action and in many respects resembles platinum, but its chemical compounds are analogous to those of zirconium. Other properties are given in the table on page 12.

Uses—Formerly, and even yet, the greatest use of thorium was for treating gas-light mantles to improve their light-giving quality. An important present use for thorium is for electron-emissive elements in radio tubes. Thorium is alloyed with tungsten for use in electric-light filaments. It is used in high-temperature refractories, in polishing compounds, as X-ray targets, as a catalyst, and in medicine. It has limited use in optical glass. Alloyed with magnesium it adds strength, and to resistance-heating alloys it adds longer life. Thorium is a radioactive metal which is a potential source of nuclear energy.

Production—In 1950 a few tens of thousands of pounds of thorium compounds were produced in the United States, mostly by two plants, one in Illinois and the other in New Jersey. Thorium metal production was negligible. The production of thorium compounds was as a byproduct of the recovery of cerium and other rare earths from monazite—just the reverse of the situation some years ago, when there was little demand for cerium but thorium was used in much larger quantities in gas-mantle manufacture.

Prices—Thorium metal prices are seldom quoted, but the 1951 price varied between \$159 and \$318 per pound. Thorium nitrate was quoted in 1950 at \$3.50 per pound, at which price it has been since the latter part of 1947,

before which it was \$2.00. In 1950 thorium oxide, 97 percent ThO_2 , was \$5.00 per pound, and 99 percent ThO_2 was \$10.00 per pound. In 1955 the Atomic Energy Commission was offering about \$4.00 per pound for ThO_2 in material concentrated to 50 percent ThO_2 and was buying mechanical concentrates of thorium minerals (other than monazite) containing 10 percent or more ThO_2 . Quotations on monazite sand, 8 percent minimum ThO_2 , dropped from a high of \$252 per ton in 1920 to a low of \$50 in 1933 and then rose to \$60 and remained there through 1946. Increased interest in thorium and restriction of foreign supplies initiated a price rise in 1947 which had brought the price to \$340 per ton by 1950.

Ore minerals—The principal ore mineral of thorium is monazite, the rare earth phosphate $(\text{Ce,La,Di})\text{PO}_4$, which almost always contains some thorium, probably as a silicate. The thorium content commonly is from 3 to 10 percent, but as much as 26 percent has been reported. Monazite is found in Washington, and another thorium-bearing mineral which has been reported in the state is allanite (orthite), a complex silicate of aluminum, iron, calcium, and rare earth, which contains up to 3.5 percent ThO_2 . Seventy or more minerals contain thorium in small to large percentages. These minerals are silicates, oxides, phosphates, fluosilicates, titanates, and columbo-tantalates. Of these, the silicates are most numerous.

Geology—Monazite is widely but sparsely distributed in granites, gneisses, and pegmatites. The mineral is almost always disseminated and rarely makes up more than a very small fraction of 1 percent of the host rock. The only common type of concentration is in placer stream gravels and beach sands.

OCCURRENCES

The map showing the numbered thorium occurrences is plate 18, on page 47 in volume 2.

DOUGLAS COUNTY

Columbia River Placer
(see under gold, placer)

FERRY COUNTY

Sherman Creek Pass (2)
(see under uranium)

Wilmont Bar Placer (1)
(see under gold, placer)

GRAYS HARBOR COUNTY

Moclips Placer (1)
(see under cerium)

KING COUNTY

Seattle Placer
(see under gold, placer)

Snoqualmie

Loc: Within the area of the Snoqualmie folio, near Snoqualmie Pass, in eastern King County. **Ore:** Thorium, cerium, uranium (?). **Deposit:** A little allanite occurs as an accessory mineral in the Snoqualmie granodiorite. **Ref:** 146, p. 9.

OKANOGAN COUNTY

Happy Hill (1)

(see under uranium)

PEND OREILLE COUNTY

Dry Canyon (1)

Loc: In Dry Canyon, which is 2 to 3 mi. E. of Pend Oreille R. The canyon is 10 mi. long, and its N. end is 3 mi. E. of Ione.

Properties—Tin is a very soft, very malleable, ductile metal having only slight tenacity and exhibiting an attractive lustrous silver-white color. It is easily fusible and alloys readily with other metals. It is corrosion resistant and at ordinary temperatures is only very slightly acted upon by air or water. Tin has three crystal-line forms. The ordinary form is unstable below 18° C., and at lower temperatures it crumbles to a gray powder. This change is known as the "tin disease" or "tin plague." Other properties are shown in the table on page 12.

Uses—In 1950 the largest use for tin was in tin plate, which accounted for 34 percent of the total. Other important uses were in solder (27 percent), bronze and brass (20 percent), and babbitt (6 percent), followed in decreasing order of importance by tinning, type metal, chemicals, miscellaneous alloys, collapsible tubes and foil, bar tin, terneplate, and pipe and tubing.

Production—In the United States, production of tin is negligible, amounting to only a small fraction of 1 percent of the consumption. Most of this production comes from Alaska, although a little recovery is made from the traces of tin which are found in the Climax molybdenum ore. A Government-owned smelter has been operating at Texas City, Texas, since 1941, but prior to that time there were no smelting facilities in the United States. Although tin is known to occur in a few places in Washington, to date there has been no production. However, 150 tons of ore estimated to carry 6 percent tin were mined but not shipped in 1907 from the Silver Hill property a few miles south of Spokane.

Prices—Tin prices have fluctuated over a wide range in the past 60 years, from a low average annual price of 13.7 cents per pound in 1897 to a high of \$1.28 in 1951. During the war years, 1941 to November 1946, the price

Ore: Thorium, cerium, uranium (?). **Ore min:** Allanite. **Deposit:** Allanite is present in a 4-ft. dike as platy crystals as much as ½ in. long. The crystals are surrounded by a reddish halo ⅛ to ¼ in. wide **Ref:** 128, p. 58.

TIN

was held by Government order at 52 cents. The price continued to be Government-regulated for some time thereafter but rose by steps to \$1.03 by September 1949. Twelve decreases brought the price down to 74.12 cents per pound by February 1950, but a year later the price was up to an all-time high of \$1.82, only to drop back to \$1.03 by August of the same year, and rise again to \$1.21½ by January 1952, where it remained for more than a year. The 1954 price averaged about 90 cents, and the price in June 1955 was 94½ cents per pound.

Ore minerals—Tin very rarely occurs native. There are only two important ore minerals of tin, and of these by far the more important is the oxide, cassiterite, SnO₂, containing 78.6 percent tin. The other is the copper-iron-tin sulfide, stannite, Cu₂S·FeS·SnS₂, containing 27.5 percent tin. At least nine other tin minerals are known, but only one of these—the lead-tin sulfide, teallite, PbSnS₂,—is found in sufficient quantity, and then rarely, to be mined as tin ore.

Geology—All primary tin deposits are genetically related to siliceous igneous rocks such as granites or pegmatites. Tin occurs rarely in contact metamorphic deposits, but most primary tin deposits are pegmatites or hydrothermal or pneumatolitic veins which have formed under high temperature and pressure at great depths. Tin minerals are commonly associated with tungsten and molybdenum, and gangue minerals are quartz, fluorite, tourmaline, or muscovite. Because cassiterite is resistant to alteration and has high specific gravity it is readily concentrated in placer deposits, and about 75 percent of the world's tin production is from such deposits. Tin placers commonly carry 0.4 to 5 pounds of tin per cubic yard, and lode deposits usually run from 1 to 8 percent tin. The sulfide vein deposits in Bolivia carry 1 to 2 percent tin.

OCCURRENCES

The map showing the numbered tin occurrences is plate 21, on page 55 in volume 2.

CHELAN COUNTY

Blewett (3)

Loc: Sec. 12, (22-17E), Blewett dist. **Owner:** Tin Exploration Co., William H. Hooper and associates, Seattle, Wash. (1951-1952). **Ore:** Tin, tungsten. **Ore min:** Native tin, scheelite. **Deposit:** Metallic tin and scheelite reported in serpentinized peridotite. Report not verified. **Ref:** 157, 158.

Chelan Butte (1)

Loc: On Chelan Butte. **Ore:** Tin. **Deposit:** Doubtful occurrence. **Ref:** 105, no. 19, 1907, p. 584; no. 26, 1907, p. 807; 12/09, p. 773.

Monitor (2)

Loc: Sec. 23, (23-19E), near Monitor. **Ore:** Tin. **Deposit:** Tin is reported in an andesite dike, but the occurrence is doubtful. **Ref:** 111.

Peshastin Creek

Loc: On Peshastin Cr., near base of Mt. Stuart. **Ore:** Tin. **Deposit:** Doubtful occurrence. **Assays:** 4% to 8% Sn. **Ref:** 43, 11/91, p. 541.

CLALLAM COUNTY

Bright Angel (1)

(see under manganese)

KING COUNTY

Bear Basin (2)

(see under silver)

Skykomish (1)

Loc: Road cut on Stevens Pass highway at E. end of Skykomish, probably in sec. 26, (11-26E). **Ore:** Tin. **Ore min:** Cassiterite. **Deposit:** 1% cassiterite in conglomerate of the Swauk formation. **Ref:** 170, p. 37.

KITSAP COUNTY

Chico (Cook-Kitchen) (1)

Loc: Near Wildcat Lk. **Access:** 4 mi. by road from Chico. **Prop:** 26 claims. **Owner:** Cook Kitchen Mining Co. (1897). **Ore:** Tin. **Ore min:** Cassiterite, wolframite, arsenopyrite, malachite. **Gangue:** Mica, tourmaline. **Deposit:** Deposit 400 ft. wide in slate and schist. **Dev:** 4 shafts, 25 to 80 ft. deep. **Assays:** 4.75% Sn, 39.75 oz. Ag, \$3.72 Au, 5.25% Cu. **Note:** This report has never been substantiated and is probably entirely erroneous. **Ref:** 63, p. 60. 105, 11/95, p. 306.

Cook-Kitchen

(see Chico)

Kitchen

(see Chico)

OKANOGAN COUNTY

Omak (1)

Loc: Just N. of American Graphite claims, which are in sec. 27, (34-29E). **Ore:** Tin reported. **Assays:** High percentage reported. **Ref:** 158.

PEND OREILLE COUNTY

Blueside (1)

Loc: Secs. 5, 8, 9, 15, 16, 21, and 22, (35-43E), along Ruby Cr. **Ore:** Tin. **Deposit:** Placer tin reported in bars of the stream for 2½ mi. **Ref:** 157.

SNOHOMISH COUNTY

Hoodoo (1)

(see under copper)

Ore Recoveries

(see Hoodoo under copper)

Snohomish Placer (2)

Loc: Near Snohomish. **Ore:** Tin reported. **Ore min:** Placer tin. **Ref:** 14, p. 51. 105, 10/03, p. 295.

SPOKANE COUNTY

Silver Hill (1)

Loc: Secs. 23 and 24, (24-43E), on Silver Hill. **Elev:** 2,900 ft. **Access:** 11 mi. of good road from Spokane. Property is crossed by railroad. **Prop:** Deeded land. **Owner:** Spokane Tin Co., Spokane, Wash. (1943). Spokane Tin Mines Co. (1907-1935). Spokane Tin and Tin Co. (1919-1922). **Ore:** Tin, tungsten, silver, lead. **Ore min:** Scheelite, wolframite, cassiterite, argentiferous galena. **Gangue:** Quartz, feldspar, andalusite, sillimanite. **Deposit:** 8 pegmatite and quartz veins in schist and quartzite av. 160 ft. in length, 3 ft. in width, and 40 ft. in depth. **Dev:** Several shafts and adits, 9,040 ft. of trenches, and 8 test pits. **Assays:** Veins av. 0.5% WO₃, 3% Sn in places. U. S. Bureau of Mines development work indicated small tonnage of 0.5% WO₃ ore. **Prod:** 125 tons of tin ore mined but not shipped. **Ref:** 2, 27, pp. 295-305. 37, pp. 57-58. 42, vol. 7, p. 212. 78, p. 27. 96, vol. 16, 1907, p. 862. 97, 1910, p. 751. 98, 1920-1926. 105, vol. 94, 1907, p. 584; vol. 94, 1907, pp. 697-698; vol. 94, 1907, p. 742; vol. 95, 1907, p. 49; vol. 96, 1908, p. 536; vol. 99, 1909, p. 871. 107, vol. 29, 1908, p. 852. 111. 112, p. 204. 116, 5/07, p. 20; no. 8, 1908, p. 13; 5/08, p. 126. 120. 158. 166.

STEVENS COUNTY

Dumbolton (3)

(see under gold)

Frisco Standard (1)

(see under silver)

Loon Lake

(see Tungsten Products under tungsten)

Tungsten Products (4)

(see under tungsten)

Young America (2)

(see under zinc)

WALLA WALLA COUNTY

Mill Creek Placer

Loc: At Mill Cr., 12 mi. E. of Walla Walla. **Ore:** Tin reported. **Deposit:** This reported occurrence is most doubtful. **Ref:** 105, 5/07, p. 584.

TITANIUM

Properties—Titanium is a lustrous silver-white metal which has a combination of properties giving it great potential value. It is light in weight, corrosion resistant, strong, and heat resistant. It is only 56 percent as heavy as steel and only 60 percent heavier than aluminum; it is as resistant to corrosion as stainless steel; its tensile strength and hardness approach that of steel; and its melting point is 300° F. higher than that of iron. Titanium is unique among the common engineering metals in its complete immunity from deleterious effects of salt water and marine atmosphere. It has the greatest resistance to shock of any known metal, retains its strength at high temperatures, has low coefficient of expansion at high temperatures, is tough and strong, but is ductile only

when very pure and free of oxygen. At ordinary temperatures it is hard and brittle but when hot it is malleable. Liquid titanium reacts with almost everything with which it comes into contact. It forms alloys with aluminum, chromium, cobalt, copper, iron, lead, nickel, tin, and other metals. Other properties are shown in the table on page 12.

Uses—Prior to 1950 about 99 percent of the titanium ore produced went into the manufacture of titanium dioxide, used extensively for white pigments, and the remainder was used in welding-rod coatings, ceramics, titanium carbides, and titanium alloys. The metal's desirable characteristics have stimulated great interest, especially in the aircraft industry, where it is being used

as sheet in jet engine shells and in various structural parts. Titanium is used in certain high-strength aluminum and magnesium alloys, in some steel alloys, and with copper and iron in titanium bronze. It is expected that with decreased production costs, higher purity metal, and improved fabricating techniques the metal will have very greatly expanded uses in the near future.

Production—The production of titanium metal is still in its infancy but is expanding rapidly and is expected to increase one-hundred-fold or more within the next few years. In 1946 less than 100 pounds of the metal was made; the following year less than 1,000 pounds was made; and it was not until 1948 that titanium metal was produced commercially. Production amounted to 30 tons in 1949 and was 550 tons in 1951, 1,100 tons in 1952, 2,241 tons in 1953, and 5,300 tons in 1954. The only production in the western part of the United States has been at a plant at Henderson, Nevada.

Prices—Some of the first commercially produced titanium metal sold for as high as \$7.00 per pound in 1948, but the price dropped to \$5 the same year and remained at that figure through 1953. In June 1955 the price was \$3.50 per pound for titanium containing a maximum of 0.5 percent iron. This price corresponds to that of aluminum 60 years ago or magnesium 45 years ago, and if improved production methods can be developed so that titanium prices can be brought down to a competitive level, demand for the metal may be expected to expand tremendously. Ilmenite titanium ore, containing 56 to 59 percent TiO_2 , sold for \$14 to \$16 per gross ton, f.o.b. Atlantic seaboard, in 1950 and had risen to \$18 and \$20 by 1953. Rutile ore, containing 94 percent or more of TiO_2 , sold as low as $3\frac{1}{2}$ to $4\frac{1}{2}$ cents per pound in 1950 but was at 5 to 6 cents in 1953.

Ore minerals—More than 60 minerals contain titanium, but about 97 percent of the titanium ore mined is the iron

titanate, ilmenite, FeTiO_3 , which contains 31.6 percent titanium. The other 3 percent mined is the oxide, rutile, TiO_2 , containing 60.0 percent titanium, although some of the ore marketed as rutile actually is a crystal modification, brookite, or more rarely another modification, octahedrite (anatase). Similarly, some ore called ilmenite probably is a closely allied mineral, arizonite. Furthermore, much ilmenite is partially altered to leucoxene. Other minerals which occasionally occur in quantities large enough to be mined are the calcium titanate, perovskite, CaTiO_3 , containing 58.9 percent titanium, and the calcium titano-silicate, titanite (sphene), CaTiSiO_5 , containing 40.8 percent titanium. Magnetite is often titaniferous, containing from 3 to 15 percent titanium, but in these instances the result usually is that the magnetite is too high in titanium to be acceptable as iron ore and too low in titanium to be usable as a source of that metal.

Geology—Titanium is the ninth most abundant element in the earth's crust and is the fourth most abundant metallic element suitable for engineering uses, being exceeded only by aluminum, iron, and magnesium. It is present in almost all igneous rocks and in sedimentary and residual rocks derived from them. Most of the world's large primary deposits of titanium are associated with basic igneous rocks, such as anorthosite, gabbro, and pyroxenite, but some are found in other rocks, such as syenite and metamorphic rocks. Minor occurrences are found in quartz veins. A large part of the titanium mined is in black sands in beach placers derived from primary deposits and from accessory titanium minerals in igneous, metamorphic, and sedimentary rocks. Accessory titanium minerals are sometimes concentrated also in residual clays or laterites derived from other rocks. Titanium has been reported in most, if not all, of these types of deposits in Washington, but to date none has been proven to be commercial.

OCCURRENCES

The map showing the numbered titanium occurrences is plate 21, on page 55 in volume 2.

ASOTIN COUNTY

Clarkston Placer (1)
(see under gold, placer)

Snake River Placer
(see under gold, placer)

CHELAN COUNTY

First Creek (1)
Loc: On First Cr. ridge approx. $\frac{1}{4}$ mi W. of the highway and 2 mi. W. of Lk. Chelan, probably in sec. 8, (27-21E). **Ore:** Titanium, iron. **Ore min:** Ilmenite. **Ref:** 67, p. 26.

CLALLAM COUNTY

Cedar Creek Placer (3)
(see under gold, placer)

Lovelace Placer
(see Shi Shi Beach Placer under gold, placer)

Shi Shi Beach Placer (1)
(see under gold, placer)

Starbuck Placer

(see Cedar Creek Placer under gold, placer)

Yellow Banks Placer (2)

(see under gold, placer)

CLARK COUNTY

Brush Prairie Placer (1)
(see under gold, placer)

Camas Placer (2)

Loc: Near Camas. **Ore:** Titanium, gold. **Ore min:** Ilmenite, magnetite, free gold. **Gangue:** Quartz. **Deposit:** Placer "black sands." **Assays:** A sample of concentrate showed 1,282 lb. ilmenite, 90 lb. magnetite, \$1.34 Au per ton (1905). **Ref:** 38-A, pp. 1218-1219. 126, p. 14.

DOUGLAS COUNTY

Columbia River Placer
(see under gold, placer)

FERRY COUNTY

Wilmont Bar Placer (2)
(see under gold, placer)

Wilmont Creek (1)

Loc: On N. slope from W. tributary of upper Wilmont Cr., probably in sec. 6, (31-35E). **Access:** 3 mi. by trail plus 19 mi. by road from Impach. **Prop:** Indian Reservation land. **Owner:** Deposit discovered by A. E. Wilson in 1906. **Ore:** Titanium. **Ore min:** Ilmenite. **Deposit:** Granite cut by 3 dikes or veins of quartz containing low percentage of coarse ilmenite; also muscovite, biotite, and feldspar. **Dev:** Open cuts, caved adit (1943). **Assays:** A dike with max. thickness of 8 ft. est. to contain 2% to 3% ilmenite. A 40- to 50-ft.-wide dike is nearly barren. **Prod:** 5 tons of mineral reported shipped to Essen, Germany. **Ref:** 122, p. 151. 158.

GARFIELD COUNTY**Pomeroy Placer**

(see under gold, placer)

GRAYS HARBOR COUNTY**Damons Point Placer (1)**

Loc: Damons Point, on the ocean beach. **Ore:** Titanium, gold. **Ore min:** Ilmenite, free gold, zircon. **Gangue:** Quartz, garnet. **Deposit:** Beach placer. **Assays:** Large sample showed 689 lb. ilmenite, 43 lb. zircon, \$0.05 Au per ton. **Ref:** 38-A, pp. 1216-1217. 126, pp. 13-14.

Dennis

(see Elma under iron)

Elma (2)

(see under iron)

KING COUNTY**Northwestern Realty**

(see Rainy under gold)

Rainy (1)

(see under gold)

Western States Copper

(see Rainy under gold)

KITTITAS COUNTY**Big Z**

(see Zerwekh under gold)

Zerwekh (1)

(see under gold)

LEWIS COUNTY**Winlock Placer (1)**

Loc: On small stream near center of sec. 27, (12-2W), about 1 mi. E. of Winlock. **Owner:** Art Gates, Toledo, Wash. (1952). **Ore:** Titanium. **Ore min:** Ilmenite. **Gangue:** Sand. **Deposit:** A sample of sand from a small stream channel contained about 10% ilmenite. **Ref:** 158.

OKANOGAN COUNTY**Crounse Placer (3)**

(see under gold, placer)

Fuller (2)

(see under iron)

Lone Pine

(see Fuller under iron)

Pateros

(see Fuller under iron)

Similkameen Falls Placer (1)

(see under gold, placer)

Strawberry Creek Placer

(see Crounse Placer under gold, placer)

PACIFIC COUNTY**Beards Hollow Placer (1)**

(see under platinum)

Fort Canby Placer (2)

(see under gold, placer)

McGowan Placer (4)

(see under iron)

Sand Island Placer (3)

(see under gold, placer)

SNOHOMISH COUNTY**Pilchuck Creek (1)**

(see under iron)

SPOKANE COUNTY**Excelsior (1)**

Loc: Secs: 20, 21, 22, 23, 28, and 29, (24-44E), just W. of Mica. **Elev:** 2,450 to 2,600 ft. **Access:** 15 mi. by road to center of Spokane. Three railroads cross the deposit. **Prop:** Deposit covers 478 acres. **Ore:** Titanium. **Ore min:** Ilmenite, kaolinite. **Deposit:** High-alumina residual basaltic clay containing an av. of 7.1% TiO₂ covers 478 acres to av. depth of 17.4 ft. and has an av. of 21.4 ft. of unconsolidated overburden. **Dev:** 139 drill holes having total footage of 4,633 ft. drilled by U. S. Bureau of Mines in 1943-1944. **Assays:** Deposit av. 7.1% TiO₂, 28.71% available Al₂O₃, 5.59% available Fe₂O₃. **Reserves:** Drilling outlined 12,533,000 dry tons of indicated ore containing 890,000 tons of TiO₂. **Ref:** 137. 148-A.

STEVENS COUNTY**Marcus Placer (1)**

(see under gold, placer)

TUNGSTEN

Properties—Tungsten is a light-gray to brownish-black metal in its powdered form but is brilliant white when fused. No other element is known to have a lower vapor pressure or higher tensile strength, and only carbon has a higher melting point. Tungsten is one of the heaviest of metals, its density being almost twice that of lead. It is very hard, ductile, strong, and elastic. It conducts heat fairly well, is very stable in acids, and is resistant

to chemical action. In artificial compounds it shows valences of 2, 3, 4, 5, and 6, but in its only important natural minerals it has a valence of 6. Other properties are shown in the table on page 12.

Uses—About 90 percent of the tungsten consumption is in ferroalloys, mostly high-speed tool steel; 5 percent goes into tungsten carbide; and the remainder, into non-

ferrous alloys, unalloyed tungsten metal, and chemicals. The pure metal is used in electric lamp filaments, for which use no satisfactory substitute is known. It is also used for plating special laboratory equipment, for contact points in electrical apparatus, and as a catalyst in certain industrial chemical reactions. The metal's greatest value lies in its property of imparting increased hardness, toughness, elasticity, and tensile strength to steel, but perhaps its most remarkable property is that of making steel retain its hardness when hot, even at red heat. Of the many nonferrous tungsten alloys the most important is stellite, a cobalt-chromium-tungsten alloy that is used to face cutting tools. Tungsten carbide also is used to face cutting tools, it being the hardest artificial material in common use, having a hardness of 9.8 (Moh's scale) as compared with 10 for diamond. Small amounts of tungsten are used in chemicals to flameproof and waterproof fabrics, in dyes, and in other applications.

Production—In most years, imports of tungsten ore into the United States are greater than domestic production, and imports generally have exceeded production in a ratio of about two to one. The first tungsten mined in Washington was from the Germania mine in southern Stevens County in 1904, and some ore was produced in the state each year thereafter through 1918. After a period of inactivity, production began again in 1930 and has been almost continuous through 1955. Production in this state has never been large, and the maximum was 303 short tons of 60-percent WO_3 concentrate in 1938. Total production from 1900 through 1950 has been 1,326 short tons of 60 percent WO_3 concentrate, which is 1.01 percent of the United States total and causes Washington to rank seventh in output among the states. Many occurrences of tungsten minerals are known in 14 of the 39 counties in Washington, but most of the occurrences are in 3 north-eastern counties, Okanogan, Ferry, and Stevens. A few properties have recorded production, but the most constant and largest output has been from the Germania mine and adjacent properties.

Prices—Tungsten ore prices are based on the short-ton unit of 20 pounds. The prices have fluctuated greatly in the past half century, rising from an annual average price of \$5.71 per unit in 1908 to \$33.98 by 1916, dropping to a

record low of \$2.25 by 1925, rising irregularly to \$13.13 by 1929, and dropping to \$9.20 by 1932. The average yearly price rose again to \$23.44 by 1940 and stayed near this level until April 1951, when the Federal Government set its purchase price at \$63 per unit. Tungsten metal sold at \$1.50 per pound in 1933; in 1948 metal of 98.8 percent purity was quoted at \$2.90 per pound, and 99.9 percent, at \$4.50. In March 1953 tungsten metals of the same purity were priced at \$5.85 and \$7.75, and the prices in June 1955 were \$4.39 and \$4.65, respectively.

Ore minerals—Tungsten does not occur uncombined in nature, and is found in relatively few minerals. Of the sixteen or so known tungsten-bearing minerals only four are of commercial importance, and three of these are members of a single isomorphous series. This series consists of the tungstates of iron and manganese, in which the manganese tungstate, huebnerite, $MnWO_4$, containing 76.6 percent WO_3 , is one end member and the iron tungstate, ferberite, $FeWO_4$, containing 76.3 percent WO_3 , is the other. Intermediate members are known as wolframite, $(Mn,Fe)WO_4$, and contain from 76.3 to 76.6 percent WO_3 . The other tungsten ore mineral is the calcium tungstate, scheelite, $CaWO_4$, containing 80.6 percent WO_3 . The brilliant blue-white fluorescence of scheelite under ultraviolet light is an aid in prospecting for this otherwise rather inconspicuous mineral. Buyers' tolerances of impurities in tungsten ores are variable, but penalties are generally charged for more than 1.6 percent tin, 0.2 percent arsenic, 0.1 percent copper, 0.05 percent phosphorus, 0.05 percent antimony, 0.4 percent bismuth, or 1.0 percent sulfur. Most ore mined in the United States contains 0.4 to 2.5 percent WO_3 .

Geology—Tungsten occurs in veins, replacements, segregations, and contact-metamorphic deposits within or near the margins of siliceous igneous rocks such as granites and pegmatites. It is commonly associated with tin or molybdenum, with pyrite and chalcopyrite, and less frequently with sphalerite and galena. Common associates in contact-metamorphic deposits are copper minerals, molybdenite, magnetite, garnet, epidote, and diopside. The tungsten minerals, because of their high specific gravity, tend to concentrate readily in placer deposits, generally close to their primary source.

OCCURRENCES

The map showing the numbered tungsten occurrences is plate 22, on page 57 in volume 2.

ASOTIN COUNTY

Joseph Creek (1)

Loc: On Joseph Cr. near its confluence with Grande Ronde R. **Owner:** H. B. Owsley, Pomeroy, Wash. (1939). **Ore:** Tungsten. **Ref:** 158.

CHELAN COUNTY

Blewett (4)

(see under tin)

Blewett Tungsten (3)

Loc: Sec. 1, (22-17E), Blewett dist. **Access:** About 0.2 mi. up Culver Gulch road from Blewett Pass highway. **Ore:**

Tungsten. Ore min: Scheelite. **Deposit:** Quartz vein 4 in. wide and exposed for 155 ft. contains scattered crystals of scheelite. **Dev:** 270-ft. adit with 90-ft. drift and some other old workings. **Ref:** 158.

Holden (1)

(see under copper)

Howe Sound

(see Holden under copper)

Irene

(see Holden under copper)

Red Mountain (2)

(see under copper)

Royal

(see Red Mountain under copper)

FERRY COUNTY

Addison (9)
(see under copper)

Apex
(see Big Chief under lead)

Big Chief (6)
(see under lead)

Chief
(see Big Chief under lead)

Faithful Surprise
(see Morning Star under gold)

Friedlander (10)
Loc: SW¼SE¼ sec. 31, (30-34E). **Access:** 5 mi. by road E. of Harlinda. **Ore:** Tungsten. **Ore min:** Wolframite, scheelite. **Deposit:** Sparsely mineralized quartz vein 12 in. wide in mica schist. **Dev:** Round pit 8 ft. deep and 15 ft. in dia. **Prod:** None known. **Ref:** 37, p. 25.

Gwin (5)
(see under silver)

Hall Creek
(see Gwin under silver)

Kelly Camp (3)
Loc: E½ sec. 4, (38-32E). **Elev:** 5,000 ft. **Access:** 18 mi. by road to railroad at Republic. **Owner:** Chas. J. Weller, Republic, Wash. (1954—). Federal Mining & Smelting Co. (1943). Ole Aavestrud and C. J. Weller, Coulee City, Wash. (1946-1954). **Ore:** Tungsten, copper, molybdenum. **Ore min:** Chalcopyrite, scheelite, magnetite, molybdenite. **Gangue:** Garnet, epidote, calcite. **Deposit:** Contact-metamorphic zone along W. side of a small roof pendant. Considerable amount of low-grade milling ore. **Dev:** 120-ft. westward-trending adit, several shafts, and numerous open cuts. **Improv:** 25-ton mill at Curlew Lk. (1952). **Prod:** 10 tons for mill test 1951, 1954, 1955. **Ref:** 37, p. 26. 133, p. 35. 158.

Laurier
(see Talisman under copper)

Lucile Dreyfus
(see Morning Star under gold)

Mineral Hill
(see Morning Star under gold)

Morning Star (1)
(see under gold)

Orion (7)
(see under silver)

Pacific Mutual
(see Addison under copper)

Silver Leaf (8)
(see under silver)

Surprise (4)
Loc: Near old Kettle Falls road 12 mi. E. of Republic, in face of cliff at top of talus slide. **Elev:** 100 or 150 ft. above bottom of a narrow canyon. **Access:** 12 mi. by road and ½ mi. by trail from railroad at Republic. **Owner:** Jake Rounds and Mrs. Jones, Republic, Wash. (1942). **Ore:** Tungsten. **Ore min:** Scheelite. **Deposit:** Specks of scheelite scattered through tuffaceous zone 8 ft. wide in limestone near quartz monzonite contact. **Dev:** Small open cut. **Assays:** Est. at less than 0.5% WO, in richest stringers. Does not appear promising. **Ref:** 158.

Talisman (2)
(see under copper)

Virginia
(see Morning Star under gold)

KING COUNTY

Devils Canyon (1)
(see under molybdenum)

Jack Pot (2)
(see under zinc)

KITSAP COUNTY

Chico (1)
(see under tin)

Cook-Kitchen
(see Chico under tin)

Kitchen
(see Chico under tin)

KITITITAS COUNTY

Big Dome (1)
(see under copper)

LEWIS COUNTY

Eagle Peak (1)
(see under copper)

LINCOLN COUNTY

Crystal
(see under lead)

OKANOGAN COUNTY

Adams
(see Moncosilgo under copper)

Antimony Queen (5)
(see under antimony)

Auberton
(see Windiate-Auberton)

Bi-Metallic (33)
(see under molybdenum)

Border Lord (2)
Loc: On Apex Mtn., just S. of Wolframite (Hatfield) property. **Access:** 43 mi. N. of Winthrop by road and 13 mi. of trail. **Prop:** 7 unpatented claims. **Owner:** Border Lord Mining Corp., Seattle, Wash. (1952—). **Ore:** Tungsten. **Ore min:** Wolframite, scheelite, pyrite. **Gangue:** Quartz. **Deposit:** Vein as much as 10 in. thick. **Dev:** Open cuts. **Ref:** 37, p. 41. 158.

Boundary
(see Wolframite)

Buck Mountain (Buckhorn) (42)

Loc: On a ridge about 1½ mi. SW. of peak of Buck Mtn., in NE¼ sec. 33, (34-24E). **Prop:** 1 claim. **Owner:** Kenneth Mosby, Brewster, Wash. (1954). **Ore:** Tungsten, molybdenum. **Ore min:** Scheelite, molybdenite, tetrahedrite, pyrite. **Deposit:** Biotite granite cut by quartz vein exposed for 500-ft. length and width of 2 in. to 3 ft., sparsely mineralized. **Dev:** 2 adits, shaft, trenches. **Prod:** 1 shipment of silver ore reported. **Ref:** 158.

Buckhorn

(see Buck Mountain)

Buckhorn

(see Magnetic under copper)

Bunker Hill

(see Silver King under lead)

Caaba

(see Kaaba under lead)

Campbell

(see Holden-Campbell under gold)

Chelan (15)

(see under gold)

Copper Queen (29)

(see under copper)

Copper World Extension (34)

(see under copper)

Corson (44)

(see under molybdenum)

Crystal Butte (32)

(see under iron)

Dixie Queen

(see Antimony Queen under antimony)

Doris Barbara (12)

(see also Holden-Campbell under gold)

Loc: NW¼NE¼ sec. 10, (30-22E), Squaw Cr. dist. **Prop:** Part of Holden-Campbell group. **Ore:** Tungsten, copper. **Ore min:** Scheelite, pyrite, and a little chalcopyrite. **Deposit:** A 2- to 5-ft. quartz vein carries rather large amounts of scheelite in places. **Dev:** 75-ft. adit. **Ref:** 158.

Dutch John (Sherwood, Lodge, Texas Creek) (6)

Loc: W½SW¼, E½ NW¼, and W½NE¼ sec. 2, (31-22E), on top and NW. slope of Lookout Mtn. **Elev:** 3,400 ft. **Access:** 4 mi. by road up Texas Cr. from Carlton, thence 1 mi. S. to property. **Prop:** Three 80-acre blocks leased from State. **Owner:** H. E. Seneff, S. J. Sherwood, and W. L. Lodge (1943). **Ore:** Tungsten, copper, molybdenum. **Ore min:** Molybdenite, scheelite, magnetite, pyrite, chalcopyrite, hematite. **Gangue:** Garnet, epidote, calcite. **Deposit:** Contact-metamorphic replacement of calcareous beds. One 3- to 9-ft. garnet bed is exposed for 850 ft. Garnet rock av. 80% garnet. **Dev:** A 185-ft. adit, a 35-ft. adit (caved), a 12-ft. shaft, and numerous open cuts. **Improv:** Cabin. **Assays:** Not more than 0.25% scheelite. **Ref:** 37, pp. 51-52. 133-B, pp. 45-46. 158.

Ferris R. Ford

(see Wolframite)

Fluorspar

(see Tonasket under copper)

49th Parallel (23)

(see under copper)

Four Metals (21)

(see under lead)

Golden Chariot (24)

(see under copper)

Golden Eagle (16)

Loc: Near W. line SW¼ sec. 13, (30-22E), on N. side of Squaw Cr. 200 ft. W. of Highland Light road. **Elev:** 1,900 ft. **Access:** ½ mi. W. of Methow highway. **Prop:** Part of the Methow group (?). **Ore:** Tungsten. **Ore min:** Pyrite, scheelite. **Deposit:** A 2-ft. quartz vein which carries a small amount of pyrite and some scheelite. This is the same vein as that on the

Mineralite claim. **Dev:** Shaft more than 70 ft. deep. **Assays:** Less than ¼% scheelite. **Ref:** 37, p. 50. 158.

Grant

(see Roosevelt under iron)

Grubscher

(see Gubser under lead)

Gubser (38)

(see under lead)

Hargrove

(see Silver King under lead)

Hatfield

(see Wolframite)

Highland (8)

(see under gold)

Highland Light

(see Highland under gold)

Holden-Campbell (13)

(see under gold)

Homestake (9)

(see also Methow under gold)

Loc: NW¼SE¼ sec. 12, (30-22E), Squaw Cr. area. **Prop:** Part of the Methow group. **Ore:** Tungsten. **Ore min:** Pyrite, scheelite. **Gangue:** Quartz. **Deposit:** 15-ft. vein exposed for 50 ft. Vein carries a large amount of pyrite and considerable scheelite. **Dev:** 50-ft. shaft from which 2 drifts have been driven. **Ref:** 158.

Homestake, long adit (7)

(see also Methow under gold)

Loc: Center W½ sec. 7, (30-23E), just above ranch buildings W. of the London mill, Squaw Cr. area. **Prop:** Part of the Methow group. **Ore:** Tungsten. **Ore min:** Scheelite. **Deposit:** Quartz vein 3 ft. wide carries considerable scheelite. **Dev:** 850-ft. adit and an open cut. **Ref:** 158.

Hunter (10)

(see under gold)

Iron Mask

(see Copper World Extension under copper)

Kaaba (22)

(see under lead)

Kaaba-Texas

(see Kaaba under lead)

Lady of the Lake (40)

(see under silver)

Lodge

(see Dutch John)

London

(see Methow under gold)

Lone Star (37)

(see under lead)

MacLean

(see Roosevelt under iron)

Magnetic (30)

(see under iron)

Methow (11)

(see under gold)

Milwaukee (7A)

Loc: N½SE¼ sec. 7, (30-23E), on E. side of Methow R. **Elev:** 100 ft. above river. **Ore:** Tungsten, copper. **Ore min:**

Pyrite, scheelite, secondary copper minerals. **Deposit:** Vein consisting of 12 in. of quartz on the hanging wall separated by a 1½-ft. basic dike from 3 in. of quartz on the footwall. **Dev:** 125-ft. adit. **Assays:** Not more than ¼% scheelite. **Ref:** 158.

Mineralite (17)

(see also Methow under gold)

Loc: NW¼SE¼ sec. 13, (30-22E), Squaw Cr. dist. **Access:** On W. side of the Methow road and about 200 ft. above it. **Prop:** Part of Methow group. **Ore:** Tungsten, copper. **Ore min:** Pyrite, chalcopryrite, scheelite. **Deposit:** A 2- to 4-ft. quartz vein traceable for several hundred ft. on the surface. **Dev:** Open cuts. **Assays:** Less than ¼% scheelite. **Ref:** 158.

Minnie (4)

(see under gold)

Moncosilgo (26)

(see under copper)

Monse (43)

Loc: 12 mi. NE. of Monse, on S. slope near base of a mountain. **Access:** Within ½ mi. of road. 11 mi. to railroad at Monse. **Prop:** 1 claim. **Owner:** Phil Bedard and Jack Barnes, Monse, Wash. (1943). **Ore:** Tungsten. **Ore min:** Scheelite. **Gangue:** Garnet. **Deposit:** Irregular tactite overlying granite. Outcrop covers about 30 by 70 ft. Best scheelite is in areas of coarsely crystalline garnet. **Assays:** 6 samples across widths of 4 to 6 ft. gave weighted av. of 0.59% WO₃. **Ref:** 157. 158.

Montgomery

(see Tonasket under copper)

Neutral

(see Magnetic under iron)

New Deal

(see Antimony Queen under antimony)

New London

(see Methow under gold)

O. K. (25)

(see under copper)

Okanogan (14)

(see under gold)

Paymaster (18)

(see under gold)

Pennington

(see Chelan under gold)

Rainbow (28)

Loc: Near SE. cor. sec. 14, (40-30E), 2,500 ft. W. of Magnetic mine workings. **Elev:** 5,000 ft. **Access:** Trail from Magnetic mine. **Ore:** Tungsten. **Ore min:** Scheelite, pyrite, pyrrhotite. **Gangue:** Garnet, epidote. **Deposit:** Quartzite and contact-metamorphosed limestone contain a few scattered crystals of the ore minerals. **Dev:** 460-ft. adit, several shafts. **Improv:** 2 old log cabins (1940). **Ref:** 158.

Reedy

(see Antimony Queen under antimony)

Roosevelt (19)

(see under gold)

Roosevelt (Grant) (31)

(see under iron)

Sheep Track (1)

Loc: On N. side of Wolframite Mtn. **Access:** Trail. **Prop:** 1 claim. **Owner:** Mrs. George Savage (1918). **Ore:** Tungsten. **Ore min:** Wolframite. **Gangue:** Quartz, muscovite. **Deposit:**

A 4-in. quartz vein in which are a few blades of wolframite. **Dev:** Open cut. **Ref:** 158.

Sherwood

(see Dutch John)

Silver King (39)

(see under lead)

Silver Seal

(see Antimony Queen under antimony)

Silver Tip

(see Starr under molybdenum)

Star

(see Lone Star under lead)

Starr (35)

(see under molybdenum)

Strawberry Lake (27)

(see under iron)

Teddy Roosevelt

(see Roosevelt under iron)

Texas Creek

(see Dutch John)

Tonasket (36)

(see under copper)

Twin Pine (45)

(see under zinc)

Washington (20)

(see under gold)

Windiate-Auberton (41)

Loc: SW¼SW¼ sec. 3, (34-29E), near Crawfish Lk. **Access:** ½ mi. private road and 4.2 mi. county road N. from Omak-Nespelem highway. **Owner:** S. R. Windiate and Steve Auberton, Omak, Wash. **Ore:** Tungsten, copper. **Ore min:** Scheelite, chalcopryrite. **Gangue:** Garnet, epidote, calcite. **Deposit:** Tactite zone in limestone bed 3 ft. thick in a metasediment series at its contact with quartz monzonite contains sparsely scattered scheelite and a high-grade streak about 3 in. wide which might contain about 2% scheelite. **Dev:** 40-ft. incline. **Assays:** Tungsten content probably is less than 0.5% in a zone 3 ft. wide, 20 ft. long, and unknown depth. **Ref:** 158.

Wolframite (Hatfield, Ferris R. Ford, Boundary) (3)

Loc: SE¼ sec. 7, S½ sec. 8, and SE¼ sec. 18, (40-22E), at head of Tungsten Cr. **Elev:** 6,500 to 7,400 ft. **Access:** 30 mi. by road and 13 mi. by trail from Winthrop via Chewack R. and its tributaries. **Prop:** 22 unpatented claims. **Owner:** Border Lord Mining Corp., Seattle, Wash., leasing from Dr. L. S. Dewey, Okanogan, Wash. (1952—). John Hatfield, Wenatchee, Wash. (1946). Originally located in 1908. **Ore:** Tungsten. **Ore min:** Wolframite, scheelite, pyrite, sphalerite, galenobismutite, tungstite. **Deposit:** Low-dipping quartz veins from 1 to 24 in., but most 5 to 10 in., wide in granite; some opened 250 to 300 ft. **Dev:** 9 adits, 11 open cuts. Total of about 1,700 ft. of drifts and crosscuts. **Improv:** 2 cabins, small jig mill, and a small steam plant (1950). **Assays:** Zone 2 to 4 ft. wide assayed 0.15% to 0.45% WO₃. **Prod:** 6 cars of handpicked ore shipped in 1920. 30 tons shipped in 1936, and 1 ton of conc. in 1942. **Ref:** 37, pp. 36-41. 97, 1911, p. 943; 1915, p. 826. 104, 11/30/34, p. 23; 2/29/36, p. 28. 105, vol. 94, 1907, p. 11; vol. 111, 1915, p. 870. 130, p. 90. 141, p. 109. 158.

PEND OREILLE COUNTY

Hardrock Thomas (4)

(see under copper)

Little Noisy (1)
(see under zinc)

Nevell (5)
(see under gold)

Scheelite Queen (3)

Loc: Sec. 3, (35-43E), Newport dist. **Access:** On highway. **Prop:** 1 unpatented claim. **Owner:** Jack Gallagher and associates, Newport, Wash. (1941). **Ore:** Tungsten. **Ore min:** Scheelite. **Deposit:** Fracture zone in granite is said to be mineralized with scheelite. **Dev:** Open cut. **Ref:** 29, p. 72.

Stagger Inn (2)

Loc: In road cut $1\frac{1}{2}$ mi. NW. of the Stagger Inn Forest Service Guard Station on the Nordman-Metaline Falls road. **Owner:** L. E. Hines, Spokane, Wash. (1943). **Ore:** Tungsten. **Ore min:** Scheelite. **Gangue:** Wollastonite or tremolite. **Deposit:** A narrow stringer of scheelite in boulders presumably derived from a road cut which exposes a limy layer in an argillaceous sedimentary series about 1,000 ft. from the closest granite outcrops. Only the barest trace of scheelite was found in the road cut itself. **Ref:** 158.

PIERCE COUNTY

Golden Rule (1)
(see under zinc)

SNOHOMISH COUNTY

Armament (13)
(see under copper)

Blackman
(see Doris under copper)

Brown
(see Doris under copper)

Calumet
(see Glacier Peak under copper)

Chatman
(see Jerry Chatman under copper)

Copper Belle
(see under copper)

Doris (8)
(see under copper)

Eldred (5)
(see under copper)

Florence Rae (7)
(see under copper)

"45" (3)
(see under silver)

Glacier Peak (1)
(see under copper)

Golden Eagle (11)
(see under molybdenum)

Hustler (6)
(see under copper)

Iowa (9)
(see under copper)

Jackson
(see St. Louis and Jackson under copper)

Jerry Chatman (10)
(see under copper)

Jones
(see Kromona under copper)

Kromona (12)
(see under copper)

Magus
(see "45" under silver)

Marvel (14)
(see under copper)

Mint
(see Iowa under copper)

St. Louis and Jackson (2)
(see under copper)

Scriber
(see Kromona under copper)

Silver Horseshoe (4)
(see under silver)

Wayside
(see Armament under copper)

SPOKANE COUNTY

Silver Hill (1)
(see under tin)

STEVENS COUNTY

Anderson
(see Becker-Anderson-Kirkwood)

Becker-Anderson-Kirkwood (25)

Loc: Adjoining Germania property on the N. and between $\frac{1}{2}$ and $\frac{3}{4}$ mi. N. of Germania mill, probably in sec. 13, (29-37E). **Prop:** 3 unpatented claims. **Owner:** Henry Becker, Fruitland, Wash., A. H. Henderson, Spokane, Wash., Fred Kirkwood, Fruitland, Wash. (1943). **Ore:** Tungsten. **Ore min:** Scheelite and possibly a little wolframite. **Deposit:** Vertical quartz vein 2 to 3 ft. wide cutting granite. **Dev:** 60-ft. adit on vein. **Assays:** One sample showed 0.68% WO₃. **Ref:** 158.

Big Iron (1)
(see under iron)

Black Horse
(see Columbia Tungsten)

Blue Grouse (new) (18)

Loc: SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 16, (30-42E), on Blue Grouse Mtn. **Elev:** 3,700 ft. **Access:** Road from Loon Lk. **Prop:** State land. **Owner:** W. H. West, Deer Park, Wash. (1955—). Pacific Mining Co., Seattle, Wash. (1951). Leased by Big Q Tungsten Mine, Inc., Seattle, Wash. (1953-1954). **Ore:** Tungsten. **Ore min:** Huebnerite. **Gangue:** Hydrothermally altered granite consisting mostly of quartz and muscovite. **Deposit:** Huebnerite crystals $\frac{1}{4}$ in. and less disseminated in hydrothermally altered granite near its contact with argillite. **Dev:** 2 adits, 3 shafts, 6 open cuts. **Prod:** 1939, 1940. **Ref:** 37, pp. 73-76. 158. 164, p. 222.

Blue Grouse (old) (19)

Loc: Near center W. line SW $\frac{1}{4}$ sec. 15, (30-42E), on Blue Grouse Mtn. **Elev:** 3,200 ft. **Access:** Road from Deer Park. **Prop:** State land. **Owner:** W. H. West, Deer Park, Wash. (1955—). Pacific Mining Co., Seattle, Wash. (1951). Leased by Big Q Tungsten Mine, Inc., Seattle, Wash. (1953-1954). **Ore:** Tungsten. **Ore min:** Huebnerite. **Gangue:** Quartz, muscovite, kaolin. **Deposit:** Hydrothermally altered granite along its contact with argillite and quartzite. **Dev:** Caved adit, vertical

shaft, several open cuts and pits. **Prod:** 1909. \$10,000 prior to World War I. **Ref:** 4, p. 214-216. 13, p. 156. 37, pp. 73-76. 97, 1910, p. 740. 104, 6/30/32, p. 28. 105, 1910, p. 489; 1912, pp. 178-179; 1915, p. 307. 106, 12/17/31. 114, no. 14, 1910, p. 39. 129, p. 51. 141, p. 108. 158. 164, p. 222.

Boundary Silver Lead

(see Lucile under zinc)

Columbia Tungsten (Black Horse, Stockwell) (13)

Loc: SW. cor. sec. 19, (32-38E). **Elev:** 3,450 to 3,520 ft. **Access:** ¼ mi. N. of the Addy-Bissell road. 10½ mi. from Cedonia. 18 mi. from railroad at Addy. **Prop:** 15 unpatented claims. **Owner:** Columbia Tungsten Corp., Spokane, Wash. (1938-1951). Leased by E. H. Jamieson, Spokane, Wash. (1951). **Ore:** Tungsten, molybdenum, zinc, silver, gold. **Ore min:** Wolframite, scheelite, molybdenite, pyrite, minor chalcocopyrite. **Gangue:** Quartz, tourmaline. **Deposit:** Short quartz veins 2 to 15 in. wide cutting porphyritic granite of a small stock near its contact with metamorphics. Tungsten mineralization is spotty and scarce. **Dev:** An old winding adit 196 ft. long, a lower adit 80 ft. long, and an upper adit 80 ft. long. 3 diamond drill holes totaling 200 ft. Surface trenches. **Assays:** 4 samples across widths of 0.8 ft. to 2.4 ft. showed tr. to 0.02 oz. Au, tr. to 2.82 oz. Ag, nil to 0.41% WO₃, 0.01% to 0.13% Mo. **Ref:** 30, p. 65. 37, pp. 67-69. 46, pp. 115-116. 130, pp. 90-91. 157. 158.

Daisy

(see Daisy-Tempest under silver)

Daisy-Tempest (12)

(see under silver)

Douglas

Loc: 18 mi. from Colville. **Access:** Road. **Prop:** 40 acres of deeded land. **Owner:** C. E. Douglas (1940). **Ore:** Tungsten, gold, silver, copper reported. **Deposit:** Said to be large. **Ref:** 158.

Easy Money

(see Magma under zinc)

Eldorado

(see Magma under zinc)

Gaber (17)

Loc: SE¼NE¼ sec. 18, (30-42E), on Frank Gaber farm. **Access:** Road. **Prop:** Deeded land. **Owner:** Frank Gaber (1941). **Ore:** Tungsten. **Ore min:** Wolframite, limonite pseudomorphs after pyrite. **Deposit:** A 12-in. quartz vein in granite. **Dev:** Trench 8 ft. deep, 5 ft. wide, and 60 ft. long. **Assays:** 1,200 lb. of ore milled at W. H. West's mill is said to have yielded 5 lb. of wolframite conc. **Ref:** 158.

Germania (26)

(see also Roselle)

Loc: Near center SW¼ sec. 13, (29-37E), Deer Trail dist. **Elev:** 3,550 ft. **Access:** Road from Springdale on the E. or from Reardan on the S. via Wellpinit. **Prop:** 640 acres of deeded land and 50 unpatented claims, among them the Blucher, Ziethen, Zieglitz, Roon, Moltke, Exodus, Exodus Fr., Roselle. **Owner:** Tungsten Uranium Mines, Inc., Spokane, Wash. (1955—). Roselle Mining Co. (1907-1920). Germania Mining Co. (1910-1920). American Tungsten Consolidated Corp. (1917-1920). Tungsten Producers, Inc. (1932-1936). General Electric Co. (1936-1941). Tungsten Mining & Milling Co. (1947-1953). Penticton Tungsten Mines, Ltd. (1953-1955). **Ore:** Tungsten. **Ore min:** Wolframite, pyrite, scheelite, galenobismutite, molybdenite, arsenopyrite, ferritungstite. **Gangue:** Quartz, chlorite, fluorite, tourmaline. **Deposit:** Quartz veins in granite, main vein from 2 in. to 3 ft. wide. Good ore has been removed. More molybdenum and less tungsten at lower levels. Area of

high radioactivity reported on property. **Dev:** 3 adits, 800 ft., 2,000 ft., and 1,250 ft. long. Also 2 short adits and numerous open cuts. 3,100 ft. of vein length stoped. **Improv:** Buildings and mill (1955). **Assays:** Tungsten minerals represented about 5.5% of vein filling. One assay of run of mine quartz showed 1 oz. Ag, 0.02 oz. Au. From 58,202 tons of ore produced 1936-1939 an av. of 0.4% WO₃ was recovered. 32,848 tons of tailings were reworked in 1939 and an av. of 0.13% WO₃ was recovered. **Prod:** 1,400 units 1904-1931. 57,436 units 1931-1940. 38 tons conc. 1936, 60 tons conc. 1937, 326 tons conc. 1938, 221 tons conc. 1939, 86 tons conc. 1940. 1941. 1951-1955. **Ref:** 7, pp. 118-123. 30, pp. 68-69. 37, pp. 77-78. 97, 1910, 1930, 1934-1941. 98, 1920-1925. 104, 7/15/35, p. 26; 10/30/36, p. 32. 105, vol. 90, 1905, p. 176; vol. 91, 1905, p. 234; no. 5, 1910, p. 307. 106, 5/21/31; 10/20/32. 113, 2/2/37, p. 6. 114, 12/10, p. 39. 130, pp. 89-90. 133, p. 40. 133-B, pp. 67-72. 141, p. 108. 158. 164, pp. 213-216.

Germania Consolidated (Keeth, Industrial Tungsten, Norton) (27)

(see also Green)

Loc: Secs. 23, 24, and 26, (29-37E), Deer Trail dist. **Elev:** 3,300 ft. **Access:** 20 mi. by road to Wellpinit and 63 mi. to Spokane. **Prop:** Consolidation of Industrial Tungsten and Keeth mines. 160 acres of deeded land, 320 acres leased from Colville Indian Reservation. **Owner:** Germania Consolidated Mines, Inc., Spokane, Wash. (1943—). **Ore:** Tungsten, molybdenum. **Ore min:** Ferberite, molybdenite, scheelite, pyrite, magnetite, chalcocopyrite, bismuthinite. **Deposit:** Wolframite occurs in 3 quartz veins rarely exceeding 8 in. thick in granite. One vein has been traced for 1,300 ft., the other for 1,080 ft. Radioactivity on 128 acres of deeded land near N. border of company holdings. **Dev:** Veins have been opened on 3 levels, comprising 930 ft. of crosscuts and 1,230 ft. of drifts (1943). 220-ft. shaft. More than 3,000 ft. of open cuts, stopes, shafts, and adits (1945). **Improv:** 25-ton mill, camp buildings (1955). **Assays:** A representative sample showed 0.39% WO₃, 0.19% Mo, 0.6 oz. Ag. **Prod:** \$100,000 in ferberite prior to 1945. Produced 1946, 1951-1955. Received \$34,704 for 561 units WO₃ in 19,921 lb. conc. 1951-1955. **Ref:** 30, p. 68. 37, pp. 78-79. 45-A. 108, 12/40, p. 39. 133, p. 33. 133-B, pp. 67-72. 158.

Green (Industrial Tungsten?) (28)

(see also Germania Consolidated)

Loc: NE¼SE¼NE¼ sec. 23, (29-37E), Deer Trail dist. **Prop:** Part of the Germania Consolidated Mining Co. holdings (1952). **Ore:** Tungsten. **Ore min:** Wolframite, scheelite. **Deposit:** Several 1-in. quartz veins and one 6-in. quartz vein in granite. Veins contain scattered crystals of wolframite. **Dev:** 280-ft. adit. **Ref:** 158.

Harper

(see Pritchard and Harper under gold)

Harrison (20)

Loc: Near E. ¼ cor. sec. 16, (30-42E), on NE. side of Blue Grouse Mtn. **Ore:** Tungsten. **Gangue:** Quartz. **Deposit:** 24-in vein in pegmatitic granite near contact with metasediments. **Dev:** Inclined shaft. **Ref:** 158. 164, p. 221.

Heritage (4)

(see under zinc)

Industrial Tungsten

(see Green, Germania Consolidated)

Juno-Echo (16)

(see under copper)

Jupiter (21)

Loc: 1 mi. E. of Blue Grouse Mtn., Loon Lk. dist. **Ore:** Tungsten. **Ref:** 105, no. 15, 1910, p. 489.

Keeth

(see Germania Consolidated)

Kirkwood

(see Becker-Anderson-Kirkwood)

Lafayette**Loc:** Stevens County. **Ore:** Tungsten. **Ref:** 105, no. 24, 1915, p. 909.**Little Mountain (31)****Loc:** SE $\frac{1}{4}$ sec. 15, (28-41E), on Little Mtn., SW. of Deer Park. **Elev:** 2,650 ft. **Access:** 8 $\frac{1}{2}$ mi. from railroad at Deer Park. **Prop:** Deeded land. **Owner:** W. V. and Ernest Boggs and Alexander Best, Cusick, Wash., leasing from Fred M. Viles, Spokane, Wash. (1951). **Ore:** Tungsten. **Ore min:** Huebnerite, scheelite. **Deposit:** Quartz vein 4 to 8 in. wide exposed for 30-ft. length in granite. **Dev:** 3 shallow pits. **Prod:** 500 lb. of high grade. **Ref:** 157.**Longshot (10)**

(see under lead)

Loon Lake

(see Tungsten Products)

Lucile (2)

(see under zinc)

McMillan (11)**Loc:** NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 4, (34-39E), SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 33, and SW $\frac{1}{4}$ SW $\frac{1}{4}$ and NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 34, (35-39E). **Access:** 5 $\frac{1}{2}$ mi. by road to railroad at Colville. **Prop:** 160 acres deeded land. **Owner:** Don Skidmore owns surface rights. H. D. and D. E. McMillan, Colville, Wash., own mineral rights (1951). **Ore:** Tungsten. **Ore min:** Scheelite. **Deposit:** Scanty scheelite in widely scattered tactite bodies in dolomite near granite contact. Largest known tactite body is 10 by 40 ft. (1951). **Ref:** 157.**Magma (6)**

(see under zinc)

Mineral Ridge (7)**Loc:** SE $\frac{1}{4}$ sec. 31, (38-39E), Clugston Cr. area. **Access:** Road. **Prop:** 20 acres of deeded land. **Owner:** Messrs. Douglas and Peterson, Colville, Wash. (1941). **Ore:** Tungsten. **Ore min:** Wolframite. **Deposit:** Fracture zone in serpentine impregnated with quartz containing wolframite. **Assays:** Said to assay 0.61%. Not known whether this is W or WO₃. **Ref:** 30, p. 79.**Newland**

(see Longshot under lead)

Norton

(see Germania Consolidated)

Owen

(see Lucile under zinc)

Pioneer

(see Longshot under lead)

Pritchard and Harper (8)

(see under gold)

Read (9)

(see under iron)

Red Top (3)

(see under lead)

Roselle (29)

(see also Germania)

Loc: Sec. 24, (29-37E), Deer Trail dist. **Prop:** Located on SW. extension of original Germania location. Believed to have been acquired and added to the Germania group some time after 1905. **Ore:** Tungsten. **Prod:** 1904. **Ref:** 105, vol. 90, 1905, p. 176; vol. 91, 1905, p. 234. 164, pp. 213-216.**S. L. (22)****Loc:** E. of Tungsten King property in sec. 15, (30-42E), on Blue Grouse Mtn. **Ore:** Tungsten. **Deposit:** Quartzite cut by quartz vein containing huebnerite and cosalite. **Dev:** 190-ft. crosscut with 100 ft. of drifts and 30-ft. winze on vein. **Ref:** 164, p. 222.**Sand Creek (30)****Loc:** Sec. 3, (28-37E), on one of the branches of Sand Cr. **Elev:** 3,200 to 3,600 ft. **Access:** Road from Davenport. **Prop:** 200-acre Indian Agency lease. **Owner:** General Mining Co. (1939). **Ore:** Tungsten. **Ore min:** Wolframite, molybdenite. **Deposit:** Small stringers of quartz in altered granite near contact with argillite and schist contain scattered crystals of wolframite. **Dev:** 25-ft. adit, open pits and trenches. **Prod:** Several sacks of ore said to have been taken out in 1917. **Ref:** 30, p. 71. 97, 1934, p. 441. 130, p. 90. 141, p. 108. 164, p. 216.**Silver Mountain**

(see Daisy-Tempest under silver)

Stockwell

(see Columbia Tungsten)

Superior Copper (15)

(see under copper)

Tempest

(see Daisy-Tempest under silver)

Tile Creek (5)

(see under antimony)

Tungsten King (23)**Loc:** Center SE $\frac{1}{4}$ sec. 16, (30-42E), on Blue Grouse Mtn. **Elev:** 3,750 ft. **Access:** 5 or 6 mi. NE. of the town of Loon Lake by road. **Prop:** State land. **Owner:** W. H. West, Deer Park, Wash. (1955—). Deer Park Mining Co. (1910-1918). Tungsten Consolidated Mines (1910-1931). Tungsten King Mining Co. (1920). T. S. & L. Co. (1936). Blue Grouse Tungsten, Inc. (1940). Pacific Mining Co., Seattle, Wash. (1951). **Ore:** Tungsten. **Ore min:** Huebnerite, pyrite, molybdenite, cosalite (argentiferous). **Gangue:** Quartz, sericite, limonite, hematite. **Deposit:** Quartz veins parallel to the bedding in sandy schistose argillite. **Dev:** 2 adits and a shaft, caved (1940). **Assays:** A picked sample of cosalite ore assayed 27.20 oz. Ag, \$2.48 Au. **Prod:** Has produced. **Ref:** 4, pp. 215-216. 7, pp. 130-133. 30, p. 62. 37, pp. 73, 75-76. 55, p. 38. 97, 1910, p. 739. 98, 1922, p. 1666; 1925, p. 1833; 1926, p. 1595. 105, vol. 99, p. 19. 106, 12/17/31. 112, pp. 175, 203-204. 114, no. 4, 1910, p. 39. 130, p. 90. 141, pp. 108-109. 164, pp. 219-222.**Tungsten Products "west end" (Loon Lake) (24)****Loc:** Near center W $\frac{1}{2}$ sec. 16, (30-42E), on Blue Grouse Mtn. **Elev:** 3,300 ft. **Access:** Road from Loon Lk. **Prop:** 240-acre State lease. **Owner:** W. H. West, Deer Park, Wash. (1955—). O. M. Kimmel (1934). Tungsten Products, Inc. (1939). Pacific Mining Co., Seattle, Wash. (1951). **Ore:** Tungsten, tin. **Ore min:** Huebnerite, pyrite. **Gangue:** Greisen. **Deposit:** Hydrothermally altered granite and narrow quartz vein. **Dev:** 96-ft. adit, another short adit, and a shaft. **Assays:** 0.5% WO₃. Mill conc. said to show 0.2% Sn. **Prod:** 1934 (17 tons ore yielded 13 units WO₃), 1939 (100 tons ore), 1940. **Ref:** 30, pp. 61, 62. 37, p. 76. 158.**Washington Metals (14)****Loc:** S. center sec. 19, (32-38E), Summit dist. **Elev:** 4,200 ft. **Access:** $\frac{1}{2}$ mi. of road from Addy-Bissell road. 8 mi. from Cedonia. 18 mi. from railroad at Addy. **Prop:** 2 patented claims: View Nos. 1 and 2. **Owner:** Addy Development Co., Spokane, Wash. (1951—). G. L. Stockwell (1916-1917). W. J. McGowan

and Reed (1929-1930). Tungsten Mines, Inc. (1931-1943). Washington Metals Corp. (1936-1939). **Ore:** Tungsten, molybdenum. **Ore min:** Wolframite, scheelite, molybdenite. **Gangue:** Quartz, orthoclase, tourmaline. **Deposit:** Quartz veins from 2 to 12 in. wide cutting porphyritic granite. Veins pinch and swell in short distances. **Dev:** 768 ft. of drifts and crosscuts in 2 adits. **Assays:** 4 samples across widths of 4 to 12 in. showed 0.53% to 3.64% WO_3 . **Prod:** Total 10 tons conc. 1916-1917, 1929-1932, 1936-1939. 1955. **Ref:** 2-A, p. 6. 37, pp. 69-70. 157.

Western Molybdenum

(see Juno-Echo under copper)

YAKIMA COUNTY

Bird (4)

(see also Copper Mining Co. under copper)

Loc: NW¼ sec. 18, (15-12E), Bumping Lk. dist. **Elev:** 5,200 to 5,350 ft. **Access:** Truck road from Copper City. 70 mi. by road from Yakima. **Prop:** Bird, Bird Extension, and Red Bird claims. **Owner:** Copper Mining Co., Yakima, Wash. (1906—). **Ore:** Tungsten, copper. **Ore min:** Chalcopyrite, scheelite, molybdenite, arsenopyrite, pyrite. **Gangue:** Quartz, calcite. **Deposit:** Series of parallel and diverging quartz veinlets along a hydrothermally altered shear zone in granitic rock. Shear zone varies from seam up to 7 or 8 ft. wide and can be traced on surface for over 2,000 ft. **Dev:** Lower Bird 450 ft., Middle Bird 80 ft., Upper Bird 160 ft., Red Bird caved, 9 open cuts, 2 shafts. **Assays:** Upper adit had av. of about 0.75% WO_3 for

av. width of 3.3 ft. and length of 40 ft. Lower adit shows av. of about 0.1% WO_3 , 3.5 ft. wide for length of 150 ft. Better values at face of lower adit. **Prod:** 650 lb. of scheelite (63% WO_3) shipped in 1940 came mostly from Bird workings. **Ref:** 37, pp. 79-81. 41. 59. 130, pp. 84, 91. 141, p. 109.

Copper Mining Co. (5)

(see under copper)

Garibaldi (2)

(see also Copper Mining Co. under copper)

Loc: NE¼ sec. 13, (15-11E), Bumping Lk. dist. **Elev:** 5,700 ft. **Access:** 1,000 ft. N. of the end of the bulldozer road from Copper City. **Owner:** Copper Mining Co., Yakima, Wash. (1906—). **Ore:** Tungsten. **Ore min:** Scheelite (large crystals), arsenopyrite. **Deposit:** Quartz vein less than 6 in. wide in granitic rock. **Dev:** Open cut. **Ref:** 37, p. 83.

Gold Hill (1)

(see under gold)

Keystone (3)

(see under copper)

Lakeview

Loc: Bumping Lk. dist. **Prop:** Unpatented claims. **Owner:** Ball Mining Co. (1918). **Ore:** Tungsten, gold. **Dev:** 178-ft. adit, 2 large open cuts. **Assays:** As high as 50% W, \$1.25 to \$6.25 Au. **Ref:** 114, p. 167.

New Find (6)

(see under copper)

URANIUM

Properties—Uranium is a metal that is hard but ductile and malleable. It is very heavy ($2\frac{1}{2}$ times as heavy as steel) and is capable of taking a high polish. The polished metal, however, rather quickly oxidizes to a black surface. In powder form uranium is black and pyrophoric, catching on fire spontaneously upon exposure to air. In its chemical behavior it is most closely related to chromium. Other properties are given in the table on page 12. Uranium is radioactive, and the isotope U_{235} (present in natural uranium to the extent of about 0.7 percent), is fissionable—properties of utmost importance. Uranium radiates alpha rays, and in its atomic disintegration produces a series of elements including helium, radium, actinium, and lead, which emit alpha, beta, and gamma rays. Pound for pound, fissionable uranium has more than two and a half million times the heat-producing energy of coal.

Uses—By far the most important use of uranium is as a source of nuclear energy, which is utilized in the atomic bombs, and which is being developed for use in power plants for various military and industrial applications. Nonenergy uses of uranium in recent years have been largely in the chemical industries, including use as catalysts and in analytical reagents. Next in importance has been its use in ceramics—in glass for a coloring agent and to regulate the coefficient of thermal expansion of the glass. It has been used in motion picture film manufacture, in electrical equipment, and luminous paint, and it has been alloyed with steel for special uses.

Production—During the years 1945 through 1950 the United States consumption of uranium for nonenergy purposes varied between $1\frac{1}{2}$ and $2\frac{1}{2}$ tons per year. The

amount used in the atomic energy program has not been announced. Prior to World War II most of our uranium was imported, but domestic sources now produce large quantities. Data on production and imports and exports are not disclosed. Every producer of uranium ore must be licensed by the U. S. Atomic Energy Commission, and the ore must be sold either directly to the Commission or to a buyer licensed by it.

Prices—Uranium salts prices have not changed greatly in the past few years. Sodium uranate sold at \$1.25 per pound in 1936, \$1.75 in 1939, and \$1.65 from 1942 to 1948. Uranium metal prices have risen considerably, however, being quoted at \$7.00 per pound in 1943, \$20.00 in 1946, and \$50.00 per pound for high-purity metal in 1950. The Atomic Energy Commission's domestic uranium program provides for: (1) A guaranteed minimum price, effective through March 31, 1962, of \$3.50 per pound f.o.b. shipping point, for uranium oxide (U_3O_8) contained in domestic ores or mechanical concentrates assaying at least 10 percent U_3O_8 . This price does not apply to the carnotite-type and roscoelite-type ores of the Colorado Plateau. (2) Guaranteed minimum prices, effective through March 31, 1962, for the carnotite-type and roscoelite-type ores of the Colorado Plateau area, varying from \$1.50 per pound of U_3O_8 in ores containing 0.10 percent U_3O_8 to \$3.50 per pound of U_3O_8 in ores containing 0.20 percent or more U_3O_8 . (3) A bonus of \$10,000, effective until April 11, 1958, for the discovery of a new deposit and the production therefrom of the first 20 short tons of uranium ore or mechanical concentrate assaying 20 percent or more U_3O_8 . (4) The Commission will pay an additional graduated bonus of up to \$35,000, depending upon the quantity and

grade of ore, for initial production and delivery of acceptable uranium ore from new and certain existing mining properties. For new properties this bonus payment will be made on each pound of uranium oxide up to and including the first 10,000 pounds.

Ore minerals—More than 100 uranium-bearing minerals are known. In some of these uranium is the principal constituent, but in others it is only a minor part of the mineral. The more important primary minerals are the oxides, pitchblende (50 to 80 percent U_3O_8) and uraninite (65 to 90 percent U_3O_8). Some of the more common secondary uranium minerals are the potassium uranium vanadate, carnotite (50 to 55 percent U_3O_8); the calcium uranium phosphate, autunite (60 percent U_3O_8); the copper uranium phosphate, torbernite (60 percent U_3O_8); the calcium uranium vanadate, tyuyamunite, (48 to 55 percent U_3O_8); and the calcium uranium silicate, uranophane (65 percent U_3O_8). In general, uranium occurs combined as oxides, phosphates, sulfates, arsenates, carbonates, vanadates, silicates, and hydrocarbons. Uranium minerals that have been found in Washington include uraninite, pitchblende, brannerite, autunite, torbernite, uranophane, nonazite, and allanite. The latter two minerals are primarily thorium bearing but sometimes contain uranium. Other uranium minerals reported in Washington are eunerite, fergusonite, samarskite, euxenite, and cyrtolite.

Geology—Uranium ore deposits occur in a great variety of rocks of igneous, metamorphic, and sedimentary origin. Primary deposits in hydrothermal veins appear to favor felsic intrusive rocks and arenaceous metasediments as host rocks. Within the veins, associated minerals contain, in decreasing order of abundance, iron, copper, cobalt, lead, silver, nickel, and bismuth. Of these, perhaps cobalt, nickel, and bismuth are most indicative. Pegmatites commonly contain uranium minerals but almost never in commercial quantities. The potassium-rich pegmatites, or zones in them, have been indicated as most favorable for the occurrence of uranium minerals. The secondary uranium-mineral occurrences, as low-grade disseminations in the sedimentary rocks—sandstone, shale, and limestone, are currently producing large tonnages of ore in the United States. A very large part of the domestic production comes from sedimentary-type deposits of this kind, largely from the Colorado Plateau in the "four corners" region of Colorado, Utah, Arizona, and New Mexico.

Although fairly large areas in Washington are underlain by Mesozoic and Tertiary continental sedimentary rocks, and some of these areas are being prospected, no sedimentary-type deposits in which carnotite commonly occurs have yet been found here. All the verified occurrences of uranium in Washington are either in granitic rock or in metamorphic rocks intruded by granite. Uraninite and secondary uranium minerals have been found in pegmatite dikes in this state but not in commercial quantities. The more promising uranium deposits in Washington have been found (1) in and near the contact of granite and rock the granite intrudes, (2) in shear zones cutting these rock types, and (3) as secondary minerals impregnating the fractured, decomposed, and disintegrated granitic and metamorphic rocks adjacent to contacts and shear zones. In other words, primary uranium mineralization may be expected to occur under much the same conditions as does copper, gold, silver, lead, zinc, molybdenum, and other ore mineralization.

Recent developments—Uranium prospecting and exploration in Washington expanded very rapidly during the first few months of 1955, especially in Stevens and Spokane Counties. This activity was the direct result of the discovery of substantial quantities of uranium ore at the Midnite Mines property on the Spokane Indian Reservation in southern Stevens County. Many large and small mining companies and thousands of individuals staked claims on open Federal land or obtained mineral leases on State and private lands north of the Reservation throughout Stevens County. Similar exploration activity in the vicinity of Mount Spokane was triggered by the announcement of the discovery of good-grade autunite mineralization on the Dahl farm near Elk in northern Spokane County. Exploration has been active in the whole northern row of counties westward from the Idaho boundary to the western flanks of the Cascade Mountains and in the Cascades about as far south as Mount Rainier. Locations showing radioactivity are known or have been reported in at least 10 counties in this general region, and this area includes all the authenticated uranium occurrences in Washington; however, because of the tremendous interest in uranium prospecting, there probably is no county in the state in which some prospecting has not been done. To date (April 1956) only two uranium properties in Washington have shipped ore—the mine originally operated by Midnite Mines, Inc., and the Daybreak Uranium, Inc. mine on the Dahl farm.

OCCURRENCES

Because serious prospecting for uranium in Washington started only very recently and new discoveries of radioactivity are being reported each week, it is impossible to include all the uranium occurrences in the following list. Any such list would be incomplete a short time after compilation.

The map showing the numbered uranium occurrences is plate 23, on page 59 in volume 2.

CHELAN COUNTY

Holden (1)

(see under copper)

Howe Sound

(see Holden under copper)

Irene

(see Holden under copper)

Keefer Brothers (2)

(see under molybdenum)

Peshastin

Loc: 12 mi. from Peshastin. **Owner:** R. F. Brown (1897). **Ore:** Uranium, but the occurrence has not been authenticated. **Ore min:** "Probably a silicate." **Deposit:** 5-ft. ledge. **Ref:** 105, 10/16/97, p. 359.

Safety Harbor Creek (4)

Loc: Safety Harbor Cr. area. **Access:** Trail. **Prop:** 6 claims. **Owner:** Western States Uranium, Inc. (1955—). **Ore:** Uranium. **Ref:** 158.

Winesap Canyon (3)

Loc: SW¼NW¼ sec. 5, (26-21E), near head of Winesap Canyon (Oklahoma Gulch). **Access:** 5 mi. by road to railroad. **Prop:** 1 unpatented claim. **Owner:** George Goman, Winesap, Wash. (1942). **Ore:** Uranium. **Ore min:** Uraninite. **Deposit:** Pegmatite made up of feldspar, quartz, and muscovite, with very minor amount of uraninite. **Dev:** Open cut 4 ft. by 6 ft. **Ref:** 67, p. 53. 158.

FERRY COUNTY**Box Canyon (5)**

Loc: Sec. 28, (37-37E), Nancy Cr. area. **Owner:** V. L. Stevens, Colville, Wash. (1955). **Ore:** Uranium. **Deposit:** Autunite in pegmatitic gneiss. **Ref:** 158.

Hurrell (8)

Loc: Sec. 21, (36-37E), on SE. flank of Bisbee Mtn., W. of Kettle Falls. **Owner:** John Hurrell, Inchelium, Wash. (1955). **Ore:** Uranium (?). **Deposit:** Radioactivity in pegmatite. **Ref:** 158.

Lucky Leslie (1)

Loc: Near center W½NW¼ sec. 23, (38-34E), on N. side of Mt. Leona. **Elev:** 5,950 ft. **Access:** 1½ mi. by trail to N. Fk. St. Peters Cr. road, by which it is 7½ mi. to railroad at Malo. **Prop:** Lucky Leslie No. 2 and several other unpatented claims. **Owner:** Wm. Alexander and Chas. Bilderback, Sweet Home, Oreg. (1955). **Ore:** Uranium. **Deposit:** Uraninite and uranophane in irregular pegmatite lens 25 ft. long and up to 5 ft. thick along a shear zone that is parallel to schistosity in biotite schist and quartzite. **Dev:** Shallow open cut. **Assays:** Radiometric tests on samples from open cut show 0.35% to 1.40% U₃O₈ equivalent. **Ref:** 158.

Lucky 21 (2)

Loc: Near center NW¼NE¼ sec. 15, (38-34E), E. of Malo, on St. Peters Cr. **Elev:** 3,750 ft. **Access:** 7 mi. by road to railroad at Malo. **Prop:** 10 unpatented claims, including Lucky 21. **Owner:** Bert Edwards, Doug Elmes, Malo, Wash., and William B. Kleinhans, Republic, Wash. (1955). **Ore:** Uranium. **Deposit:** Uraninite and uranophane in narrow pegmatitic lenses in quartzite and schist. **Dev:** Open cuts. **Assays:** 0.325% U₃O₈ reported. **Note:** Since the original 8 claims were staked, 30 or more claims were staked nearby in a few days by various people. **Ref:** 158.

Nancy Creek (6)

Loc: SW¼SW¼ sec. 29, (37-37E), near Nancy Cr. **Access:** 2½ mi. by road to railroad. **Prop:** 8 claims and 120 acres deeded land. **Owner:** Patrick Sullivan and Darrell Newland, Colville, Wash., hold lease and have subleased to Day Mines, Inc., Wallace, Idaho (1955—). **Ore:** Uranium. **Deposit:** Uraninite and uranophane in pegmatitic lenses in gneiss. **Assays:** 0.31% to 1.45% U₃O₈ reported. **Note:** Since the original discovery in this area dozens of claims were staked within a short time. **Ref:** 158.

Oregonian (3)

Loc: W½NW¼SW¼ sec. 14 and E½NE¼SE¼ sec. 15, (38-34E), S. of St. Peters Cr. **Access:** ½ mi. by trail to N. Fk. St. Peters Cr. road, by which it is 7½ mi. to railroad at Malo. **Prop:** Oregonian and several other unpatented claims. **Owner:** Art Cooper, Sweet Home, Oreg., and Ben Butler, Republic,

Wash. (1955). **Ore:** Uranium. **Deposit:** Sparse uranophane in 50-ft. by 50-ft. outcrop of pegmatitic granite in biotite schist. **Ref:** 158.

Section 36 (7)

Loc: Sec. 36, (37-36E), near head of Nancy Cr. **Access:** About 8 mi. by road to railroad. **Owner:** Leases on 320 acres of State land held by R. C. Mulligan, R. J. Pulley, M. F. Fowler, and T. Jones, Okanogan, Wash. (1955). **Ore:** Uranium. **Deposit:** Pegmatitic granite in gneiss contains uranophane, autunite, and a little heavy black uranium mineral that probably is uraninite; also hyalite, garnet, and apatite. **Assays:** Samples reported to run as high as 0.51% U₃O₈. **Ref:** 158.

Sherman Creek Pass (4)

Loc: Vicinity of Sherman Cr. Pass, Columbia Mtn., and Sherman Pk., 17 mi. E. of Republic. **Elev:** 4,000 to 7,000 ft. **Access:** About 16 mi. by road to railroad at Republic. **Prop:** 29 or more claims. **Owner:** Sherman Creek Uranium Mines, Inc., Burl Fowler, A. J. Lane, R. R. Embody, Republic, Wash. (1954—). **Ore:** Uranium. **Ore min:** Monazite, autunite. **Deposit:** Weak radioactivity is sporadically distributed over large area near contact of granite with gneiss and schist, and local areas show considerable radioactivity. At least part of the radioactivity is concentrated in biotite-rich pegmatitic segregations, and here the radioactivity is due to the presence of monazite. Small amount of autunite has been reported along joints in talus blocks. **Dev:** Open cuts, diamond drill holes. **Assays:** "Surface samples indicated up to 0.14% U₃O₈." **Note:** Since the original discovery hundreds of claims have been staked in this area. **Ref:** 158.

Sunset Mines (9)

Loc: About 4 mi. W. of Kettle Falls. **Prop:** 7 claims. **Owner:** Sunset Mines, Inc. (1955—). **Ore:** Uranium. **Deposit:** Finely divided uranium mineral (uraninite ?) in biotite gneiss. **Assays:** Some samples ran as high as 0.4% U₃O₈. **Ref:** 158.

GRANT COUNTY**Grand Coulee (1)**

Loc: 5 mi. S. of Electric City on road to Coulee City. **Ore:** Uranium. **Deposit:** Polycrase in pegmatite. **Ref:** 158.

Peterson

Loc: Grand Coulee Dam area, possibly in Grant County. **Owner:** Ben I. Peterson, Moses Lake, Wash. (1954—). **Ore:** Uranium. **Ore min:** Uraninite, brannerite, Allanite, euxenite, and cyrtolite reported. **Deposit:** Radioactive minerals in pegmatitic granite. **Assays:** 0.06% U₃O₈ by radiometric analysis. **Ref:** 158.

KING COUNTY**Rainy (1)**

(see under gold)

Snoqualmie

(see under thorium)

Western States Copper

(see Rainy under gold)

KITTITAS COUNTY**Big Dome (1)**

(see under copper)

LEWIS COUNTY**Eagle Peak (1)**

(see under copper)

LINCOLN COUNTY

Egypt

(see Pitney Butte under molybdenum)

Germania Consolidated

Loc: 17 mi. N. of Davenport. **Prop:** 1,600 acres leased by Germania Consolidated Mines, Inc., Spokane, Wash. (1955—). **Ore:** Uranium (?). **Deposit:** "Uranium indications" found. **Dev:** Drill holes. **Ref:** 158.

Pitney Butte (1)

(see under molybdenum)

Spokane Molybdenum

(see Pitney Butte under molybdenum)

OKANOGAN COUNTY

Aeneas (3)

Loc: NW¼ sec. 15, (36-29E), on S. side of Aeneas Valley. **Access:** 19 mi. by road to railroad at Tonasket. **Prop:** Deeded land. **Owner:** Ted Eberle, Tonasket, Wash. (1955). **Ore:** Uranium. **Deposit:** Slight radioactivity along pegmatitic bands in gneiss. **Assays:** One sample showed 0.18% U₃O₈. **Ref:** 158.

American Strategic Minerals (5)

Loc: Sec. 9, (40-26E), on N. slope of Elemeham Mtn., S. of Similkameen R. **Prop:** Unpatented claims. **Owner:** American Strategic Minerals Corp., Tonasket, Wash. (1955). **Ore:** Uranium (?). **Deposit:** Radioactive black magnetic mineral in metamorphic rock. **Ref:** 158.

Bi-Metallic (2)

(see under molybdenum)

Happy Hill (4)

Loc: 4 mi. NW. of Okanogan, on Happy Hill. Probably in SE¼ sec. 14, (34-25E). **Prop:** 15 claims and some leased land. **Owner:** Sherman Creek Uranium Mines, Inc., Republic, Wash. (1955—). **Ore:** Uranium, thorium, cerium. **Ore min:** Monazite. **Dev:** Bulldozer trenches. **Assays:** As high as 5% monazite, with 2½% to 3% rare earths content and 0.06% to 0.08% U₃O₈. **Ref:** 158.

Lost Lake (1)

Loc: Near Lost Lake, along the international boundary at Molson. **Owner:** Barney Quinn (1925). **Ore:** Uranium, gold, and silver reported. **Assays:** Reported to show \$84 per ton in uranium, \$6 in silver, and \$4 in gold. **Ref:** 106, 5/16/25, p. 25.

Sanpoil (6)

Loc: Sec. 25, (35-31E), on upper part of Sanpoil R. **Prop:** Unpatented claims. **Owner:** Albert Allen (1956). **Ore:** Uranium. **Deposit:** Pegmatite containing scattered tiny grains of samarskite and radioactive violet-colored fluorite. **Assays:** Specimens reported to show max. of 0.3% U₃O₈. **Ref:** 158.

PEND OREILLE COUNTY

Bella May (new adit) (3)

(see under zinc)

Clark

(see Josephine under zinc)

Dry Canyon (6)

(see under thorium)

Golden Anchor (7A)

Loc: 9 mi. W. of Usk. **Prop:** 6 unpatented claims. **Owner:** Golden Anchor Mining and Milling Co., Spokane, Wash., leasing from George L. and Lloyd Howard, Spokane, Wash. (1955—). **Ore:** Uranium. **Deposit:** Autunite in pegmatite. **Dev:** Shallow pits. **Ref:** 158.

Grandview mine (2)

(see under zinc)

Highnoon Uranium (8)

(see also Rocky Ridge and West)

Loc: Lost Creek area. **Prop:** 10 claims and leases on 1,500 acres of land. **Owner:** Highnoon Uranium Mines, Inc., % J. R. Jones, Newport, Wash. (1955—). **Ore:** Uranium. **Deposit:** Small deposit of high-grade ore. **Ref:** 158.

Josephine (1)

(see under zinc)

Kimball Mines (9)

Loc: 7 mi. W. of Newport, 2 mi. W. of Diamond Lk., on Bert Smith farm. **Prop:** Mineral rights lease on 282 acres of deeded land. **Owner:** Kimball Mines, Inc., Spokane, Wash., leasing from Bert Smith, Newport, Wash. (1955—). **Ore:** Uranium (?). **Deposit:** Higher-than-normal radioactivity in old prospect hole in decomposed granite. **Ref:** 158.

Metaline Mining and Leasing Co. (4)

(see under zinc)

Pend Oreille Mines & Metals Co.

(see Josephine under zinc)

Ponsness (10)

Loc: Secs. 18 and 19 (?), (35-46E), near Idaho boundary, N. of Newport. **Owner:** Lloyd Ponsness, Newport, Wash. (1955). **Ore:** Uranium. **Deposit:** Autunite in weathered granite. **Ref:** 158.

Rocky Ridge (6A)

Loc: On Ruby Cr., W. of Blue Slide. **Prop:** Unpatented claims. **Owner:** Highnoon Uranium Mines, Inc., Newport, Wash. (1955—). **Ore:** Uranium. **Deposit:** Commercial-grade ore reported. **Ref:** 158.

Ruby (7)

Loc: Sec. 6, (34-44E), near Ruby. **Owner:** Lewis E. DeChenne, Cusick, Wash. (1955). **Ore:** Uranium. **Ore min:** Uraninite, autunite. **Deposit:** Pegmatite containing smoky quartz, albite, muscovite mica, a little apatite, and a few tiny garnet crystals; also has a few scattered grains of uraninite altered in part to autunite. **Ref:** 158.

Sacheen Lake (5)

Loc: Probably sec. 30 (or possibly sec. 29 or 32), (31-44E), on top of hill just E. of Sacheen Lk. **Owner:** Forrest Corwin, E. 1624 Liberty Ave., Spokane, Wash. (1939). **Ore:** Uranium (?). **Deposit:** A sample of pegmatitic granite composed of quartz, orthoclase, and a very little magnetite showed slight radioactivity in one very restricted area of the specimen. **Ref:** 158.

South Skookum Lake

Loc: About ½ mi. E. of South Skookum Lk., probably in sec. 6, (33-45E). **Prop:** 21 claims. **Owner:** Silver Dollar Mining Co., Spokane, Wash. (1955). **Ore:** Uranium. **Deposit:** Autunite in shear zone in granite. **Dev:** Bulldozer cuts. **Assays:** Channel sample across 3-ft. width showed 0.74% U₃O₈. **Ref:** 158.

Stagger Inn (11)

Loc: Near Stagger Inn Ranger Station. **Prop:** 6 unpatented claims. **Owner:** Northwest Prospecting and Development Co., Spokane, Wash. (1955). **Ore:** Uranium (?). **Deposit:** Radioactivity along granite-argillite contact. **Ref:** 158.

Starlight Uranium (8A)

Loc: Sec. 10, (32-42E), near Calispell Cr. **Prop:** 8 unpatented claims. **Owner:** Starlight Uranium Co., Frank Gibson, Deer Park, Wash. (1955). **Ore:** Uranium. **Deposit:** Autunite disseminated in rotten granite across a width of 30 ft. **Ref:** 158.

West (5A)

Loc: Near Diamond Lk. **Owner:** Highnoon Uranium Mines, Inc., Newport, Wash. (1955—). **Ore:** Uranium. **Deposit:** Commercial-grade ore reported. **Ref:** 158.

PIERCE COUNTY**Rushing River (1)**

Loc: On Rushing R. (or Rushingwater Cr. ?) on W. flank of Mt. Rainier. **Prop:** 38 unpatented claims. **Owner:** Al Nigro, Frank Stankevich, and J. L. Pennington, Tacoma, Wash. (1955). **Ore:** Uranium. **Ore min:** Pitchblende. **Assays:** Samples reported to run as high as 19.8% U_3O_8 . **Ref:** 158.

SKAMANIA COUNTY**Rainbow (1)**

(see under vanadium)

SNOHOMISH COUNTY**Broken Ridge (5A)**

(see under copper)

Keller (5)

Loc: Near Mineral City, probably in sec. 6, (28-11E). **Access:** 1 mi. by trail and about 15 mi. by road from railroad at Index. **Prop:** 8 unpatented claims. **Owner:** M. E. Keller, McKenna, Wash., and Harold Mykol, Olympia, Wash. (1955). **Ore:** Uranium. **Deposit:** Uraninite in quartz veinlets. Also some sandstone that is radioactive. **Assays:** Specimens run as high as 10% U_3O_8 . **Ref:** 158.

Kromona (4)

(see under copper)

Mackinaw (1)

(see under copper)

Molly (2)

Loc: Sec. 30, (28-11E), near Galena Lookout Station. Approx. 9 mi. E. of Index on N. Fk. of Skykomish R. **Owner:** Wm. C. Duncan, Seattle, Wash. (1951). **Ore:** Uranium, molybdenum. **Ore min:** Molybdenite, uraninite, chalcophyrite. **Ref:** 157.

Silver Creek

(see Broken Ridge under copper)

Sultan (3)

Loc: 5 mi. W. of the town of Sultan. **Owner:** A. A. Kennedy. **Ore:** Uranium. **Ref:** 1, 10/16, p. 110. 14, p. 50.

Weden Creek

(see Mackinaw under copper)

SPOKANE COUNTY**Affiliated Mines (20)**

Loc: On W. slope of Mt. Kit Carson. **Prop:** 620 acres of leased land. **Owner:** Affiliated Mines, Inc., Spokane, Wash. (1955—). **Ore:** Uranium. **Ore min:** Autunite. **Dev:** Diamond drill holes, bulldozer trenches. **Ref:** 158.

Anaconda Uranium (21)

Loc: Lee lease: $S\frac{1}{2}SE\frac{1}{4}$ sec. 23, (28-44E). Stanley lease: $NW\frac{1}{4}$ sec. 6, (27-45E). **Elev:** 2,450 to 3,056 ft. **Access:** Roads. **Prop:** 240 acres of leased land. **Owner:** Anaconda Uranium Corp., Spokane, Wash. (1955—). **Ore:** Uranium. **Deposit:** Autunite and gummite reported in granite. **Ref:** 158.

Carbon (16)

Loc: Sec. 7, (28-44E), Mt. Spokane area. **Owner:** Carbon Mining & Uranium Co., Spokane, Wash. (1955—). **Ore:** Uranium. **Ref:** 158.

Columbia Enterprises (7)

Loc: $S\frac{1}{2}SE\frac{1}{4}$ sec. 1, (28-44E), Mt. Spokane area. **Access:** 8 mi. by road to railroad at Elk. **Prop:** Several unpatented claims. **Owner:** Mt. Spokane Minerals & Uranium, Inc., Spokane, Wash., leasing to Columbia Enterprises Inc., Longview, Wash. (1955). Ownership of mineral rights on this property is currently (1955) in controversy. **Ore:** Uranium. **Deposit:** Coarse crystals of autunite along joints and irregular seams in altered pegmatitic granite. Radioactivity and float traceable for several hundred ft. **Dev:** Open pits. **Assays:** Picked sample ran 6.8% U_3O_8 . **Ref:** 158.

Curtin (18)

Loc: $W\frac{1}{2}NW\frac{1}{4}$ sec. 24, (28-44E), Mt. Spokane area. **Owner:** Oliver and Lillian Curtin leasing to Dawn Uranium & Oil Co., Spokane, Wash. (1955—). **Ore:** Uranium. **Deposit:** Autunite in granite. **Dev:** 4 out of 20 wagon-drill holes indicated commercial ore at depths of from 15 to 50 ft. **Ref:** 158.

Dahl (Daybreak) (1)

Loc: $E\frac{1}{2}NE\frac{1}{4}$ sec. 11, (28-44E), about 18 mi. NE. of Spokane, in Mt. Spokane area. **Elev:** 2,800 ft. **Access:** 8 mi. by road to railroad at Elk and about 30 mi. to railroad at Spokane. **Prop:** 80 acres of deeded land. **Owner:** Alfred L. Dahl, Elk, Wash., leasing to Daybreak Uranium, Inc., Spokane, Wash. (1955—). **Ore:** Uranium. **Deposit:** Meta-autunite occurs as veinlets and fillings of closely spaced joints in decomposed granite. 5 ore bodies in an area 250 ft. by 900 ft., being worked by open pit. **Dev:** 7 diamond drill holes (July 1955) show ore to depth of at least 100 ft. 46,300 tons proven ore reserves reported. **Assays:** Channel samples across 35-ft. width showed 0.35% to 0.80% U_3O_8 . First 10 carloads shipped av. 0.55% U_3O_8 . **Prod:** Production began Aug. 1955. Total of 5,196 tons through Sept. 1956 av. 0.3346% U_3O_8 . Also 7 carloads from nearby Huffman lease in Sept. 1956.

Dahl Uranium Mine, Inc. (5)

(see also under Stevens County)

Loc: $SE\frac{1}{4}$ sec. 1, (28-44E) and $N\frac{1}{2}SW\frac{1}{4}$ and $SW\frac{1}{4}SW\frac{1}{4}$ sec. 6, (28-45E), $1\frac{1}{4}$ mi. NE. of original discovery on Dahl (Daybreak) uranium property, in western foothills of Mt. Spokane. **Access:** Road. **Prop:** Mineral rights on 141 acres of deeded land. **Owner:** Dahl Uranium Mine, Inc. leasing from Leonard A. and Betty C. Dahl, Spokane, Wash. (1955—). **Ore:** Uranium. **Deposit:** High-grade autunite ore reported exposed in 2 places more than 100 ft. apart. One drill hole showed ore mineralization from 22 ft. to 35 ft. deep, and a second hole about 340 ft. S. of the first showed ore at 35-ft. depth. A vein 21 in. wide, exposed for 17 ft., carries up to 2% U_3O_8 . **Prod:** A few carloads reported in 1956. **Ref:** 158.

Dawn Uranium & Oil (8)

(see also Curtin, Smith)

Loc: $E\frac{1}{2}W\frac{1}{2}$ sec. 8, (28-44E) and secs. 26 and 27, (29-44E), near Elk, about 2 mi. N. of Dahl property, Mt. Spokane area. **Access:** Road. **Prop:** More than 160 acres of leased land. **Owner:** Dawn Uranium & Oil Co., Spokane, Wash., leasing from R. E. Wisemore, Spokane, Wash., and H. B. Sams, Elk, Wash., and others (1955). **Ore:** Uranium. **Deposit:** Showings of autunite reported in shallow test pits in decomposed granite. At a depth of more than 300 ft. a diamond drill hole intersected 5 ft. of steeply dipping mineralized zone containing autunite. Autunite in 2 other widely spaced holes. **Dev:** Diamond drill holes in $S\frac{1}{2}SE\frac{1}{4}$ sec. 27, (29-44E). **Ref:** 158.

Daybreak

(see Dahl and see Bair, Lowley under Stevens County)

Elk Uranium (2)

Loc: 1 mi. E. of Dahl property, and other places in Spokane and Stevens Counties. **Prop:** Mineral rights on several thousand

acres of deeded land. **Owner:** Elk Uranium, Inc., Spokane, Wash. (1955—). **Ore:** Uranium. **Deposit:** Radioactivity reported. **Dev:** Bulldozer trenches and diamond drill holes. **Ref:** 158.

Fish Lake (14)

Loc: E $\frac{1}{2}$ SE $\frac{1}{4}$ sec. 32 and W $\frac{1}{2}$ SW $\frac{1}{4}$ sec. 33, (24-42E), just N. of Fish Lk. **Access:** Paved highway crosses deposit, and railroad is within a few hundred ft. **Prop:** Deeded land. **Ore:** Uranium. **Ore min:** Secondary minerals. **Deposit:** Small irregular masses and veinlets of pegmatite near contact of granite with older metamorphic rocks. Although slight radioactivity may be detected in many places over an area of several thousand sq. ft., no concentrations of ore grade are known. **Ref:** 158.

Graham (15)

Loc: Sec. 11, (29-44E), Mt. Spokane area. **Prop:** 160-acre lease. **Owner:** Sidney Mining Co. and Mascot Mines, Kellogg, Idaho (1955—). **Ore:** Uranium. **Deposit:** Autunite found in 3 shallow pits. **Ref:** 158.

Kit Carson Uranium (3)

Loc: Center SE $\frac{1}{4}$ sec. 13, (28-44E) and sec. 18, (28-45E), S. of Dahl property. **Elev:** 3,350 ft. **Access:** Road. **Prop:** Leases on 600 acres of deeded land. **Owner:** Kit Carson Uranium, Inc., Spokane, Wash., leasing from R. B. Pulliam, Colbert, Wash. (1955—). **Ore:** Uranium. **Deposit:** Coarse autunite crystals are abundant in a 6-in. low-dipping shear zone in rotten pegmatitic granite. Ore zone 400 ft. long and 50 ft. wide reported. Two other ore bodies indicated. Ore mineralization found at depths of a few ft. to 156 ft. in about half of 52 holes drilled to depths of 50 to 156 ft. Ore from 42 to 90 ft. in one hole. **Dev:** Four 50-ft. bulldozer trenches. **Ref:** 158.

Miner (6)

Loc: NE $\frac{1}{4}$ sec. 30, (29-45E), 3 mi. NE. of Dahl property, in Mt. Spokane area. **Access:** About 8 mi. by road to railroad at Elk. **Prop:** 350 acres of deeded land. **Owner:** Dr. W. C. Miner, Opportunity, Wash. (1955). **Ore:** Uranium. **Deposit:** Radioactive ore reported to be in a zone 2 to 3 ft. wide exposed in road cut. **Dev:** Bulldozer cuts. **Ref:** 158.

Morning Sun Uranium (4)

Loc: Adjacent to the Dahl property on the E., in W $\frac{1}{2}$ NW $\frac{1}{4}$ and W $\frac{1}{2}$ NE $\frac{1}{4}$ and N $\frac{1}{2}$ SE $\frac{1}{4}$ sec. 1, (28-44E) and NW $\frac{1}{4}$ sec. 7, (28-45E), Mt. Spokane area. **Access:** 8 mi. by road to railroad at Elk. **Prop:** 240 acres of State land, in sec. 12, 160 acres $\frac{1}{2}$ mi. to the E., and 80 acres $\frac{1}{4}$ mi. to the NE. **Owner:** Daybreak Uranium, Inc., Spokane, Wash., has lease from A. L. Dahl, who is leasing from State (1955—). **Ore:** Uranium. **Ore min:** Meta-autunite. **Gangue:** Granite. **Deposit:** Ore mineralization reported to be similar to that at Dahl deposit. **Dev:** Bulldozer trenches. **Ref:** 158.

Painted Desert (12)

(see also under Stevens County)

Loc: 2 mi. S. of Dahl property. **Prop:** Mineral leases on about 1,000 acres. **Owner:** Leased by Painted Desert Uranium and Oil Co., Spokane, Wash. (1955—). **Ore:** Uranium. **Deposit:** High-grade autunite in float reported. Some uranium in one hole at depth of 20 to 40 ft. **Dev:** Diamond drill holes. **Ref:** 158.

Schaefer (13)

Loc: Secs. 19, 30, and 31, (29-44E) and secs. 24, 25, and 36, (29-43E), near Milan. **Access:** Railroad crosses property. **Prop:** Mineral lease on several hundred acres of deeded land. **Owner:** Daybreak Uranium, Inc., Spokane, Wash., leasing from Everett and Irene Schaefer (1955). **Ore:** Uranium. **Deposit:** Good autunite crystals found at a depth of 7 ft. **Ref:** 158.

Section 32 (9)

Loc: Sec. 32, (28-45E), near top of Mt. Spokane. **Ore:** Uranium. **Deposit:** Autunite in granite. **Ref:** 158.

Section 21 (10)

Loc: Sec. 21, (28-45E), near top of Mt. Spokane. **Ore:** Uranium. **Deposit:** Autunite in granite. **Ref:** 158.

Smith (17)

Loc: E $\frac{1}{2}$ SW $\frac{1}{4}$ sec. 13, (28-44E), Mt. Spokane area. **Owner:** Emma L. and Clarence I. Smith leasing to Target Uranium Co., which has made a 50-50 profit-sharing agreement with Dawn Uranium & Oil Co., Spokane, Wash. (1955—). **Ore:** Uranium. **Deposit:** Commercial ore found in 6 out of 10 wagon-drill holes. 6,650 tons of ore reported to a depth of 60 ft. **Prod:** At least 1 carload in 1956. **Ref:** 158.

Stapleton (12A)

Loc: E $\frac{1}{2}$ sec. 1, (29-44E), Mt. Spokane area. **Elev:** 2,800 to 3,100 ft. **Prop:** 320 acres of leased land. **Owner:** National Uranium Corp., Wallace, Idaho, has 10-yr. lease (1955—). **Ore:** Uranium. **Deposit:** Autunite in shear zone in pegmatitic granite. **Dev:** Adit, 6 open cuts. **Ref:** 158.

Thompson (19)

Loc: Sec. 18, (28-45E), on W. slope of Mt. Kit Carson. **Prop:** 200-acre lease. **Owner:** Leased by Tungsten Uranium Mines, Inc., Spokane, Wash. (1955—). Have profit-sharing agreement with Rayrock Uranium Co. **Ore:** Uranium (?). **Deposit:** Radioactive spring. **Ref:** 158.

Tungsten Uranium Mines (11)

(see also Germania under tungsten, Stevens County)

Loc: Sec. 18, (28-45E), 1 mi. W. of Mt. Spokane State Park and 4 mi. S. of Dahl property. **Prop:** Mineral leases on 323 acres of deeded land. **Owner:** Leased by Tungsten Uranium Mines, Inc., Spokane, Wash., from Arthur Selleck (1955). **Ore:** Uranium. **Deposit:** Autunite reported in granite. **Dev:** Bulldozer trenches. **Ref:** 158.

STEVENS COUNTY

A A (1)

Loc: Sec. 26, (40-36E), Orient dist. **Prop:** 1 unpatented claim: A A No. 2. **Owner:** Berger Benson, Spokane, Wash. (1955). **Ore:** Uranium. **Deposit:** Autunite in pegmatitic gneiss. **Ref:** 158.

Arden (4)

Loc: SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 14, (34-39E), about 1 mi. SE. of Arden. **Elev:** 1,875 ft. **Owner:** L. E. Haye, Lakeview, Wash. (1955—). **Ore:** Uranium. **Deposit:** Autunite sparsely distributed along a NE.-trending fractured zone for a length of 5 ft. in Loon Lake granite. Zone of fracturing and clay-mineral alteration is about 2 ft. wide. Considerable fluorescent hyalite in the vicinity. **Ref:** 158.

Bair (14)

Loc: E $\frac{1}{2}$ sec. 14, (27-37E), near Spokane R., on Spokane Indian Reservation. **Owner:** Daybreak Uranium, Inc., Spokane, Wash., has assignment of prospecting lease held by Mr. Bair from Spokane Indian Tribe (1955—). **Ore:** Uranium. **Ore min:** Autunite, uraninite. **Assays:** Sample from veinlets across a 30-ft. bulldozer cut showed 0.48% U₂O₅ by chemical analysis. **Ref:** 158.

Big Smoke Uranium (18)

Loc: Sec. 11, (27-37E), near Spokane R. **Prop:** The company holds prospecting permits on more than 10,000 acres of Spokane Indian Reservation land. **Owner:** Big Smoke Uranium, Inc., Spokane, Wash. (1955—). **Ore:** Uranium. **Ore min:** Uraninite, gummite. **Deposit:** 2 veins in 30-ft. fault zone in arkose near

contact with granite. Uraninite and gummite in coal in seam 8 ft. wide at depth of 14 ft. A second vein is 12 in. wide and is 30 ft. N. of the first. **Dev:** Bulldozer pit 12 ft. deep. **Assays:** Chemical assay of soil from 3-ft. depth showed 0.28% U_3O_8 . A 2-ft. vein showed 0.50% U_3O_8 equivalent, but chemical assay showed 1.30% U_3O_8 . **Prod:** A few carloads shipped in 1956. **Ref:** 158.

Boyd (11)

Loc: Adjoining Midnite mine on E. **Prop:** 458 acres of Spokane Indian Reservation land allotted to Ed Boyd and other members of the Boyd family. **Owner:** Leased by Dawn Mining Co., Portland, Ore. (1956). **Ore:** Uranium. **Deposit:** Similar to adjacent Midnite deposit. **Assays:** 50 ft. of ore in drill hole av. 0.30% U_3O_8 . **Ref:** 158.

Calispell Peak

(see Cannon)

Cannon (Calispell Peak, Railway Dike) (5)

Loc: Near W. $\frac{1}{4}$ cor. sec. 33, (34-42E), on headwaters of Chewelah Cr. **Elev:** 3,750 to 4,340 ft. **Access:** About $\frac{1}{2}$ mi. by trail from the end of the road up Chewelah Cr. **Prop:** 1 claim. **Owner:** Merikay Mines, Laurence Hammond, New York, N. Y., leasing from Northern Pacific Ry. (1952). Earl and Perry Cannon, Chewelah, Wash. (1950). **Ore:** Uranium, columbium, tantalum, beryllium. **Ore min:** Columbite, uraninite, autunite, torbernite, beryl, a few specimens of bismutite. **Gangue:** Quartz, feldspar, muscovite. **Deposit:** Pegmatite dike in roof pendant of schist near intrusive granite. Pegmatite zone is 50 ft. wide and has a length of 1,050 ft. Only a few crystals of uraninite and columbite found. **Dev:** 2 open cuts, 8 trenches, 353-ft. adit. **Assays:** Uranium and columbium content below commercial grade. **Prod:** 6 tons of beryl in 1952. **Ref:** 158.

Crawford

(see Indian Chief Uranium)

Dahl Uranium Mine, Inc. (12)

(see also under Spokane County)

Loc: Sec. 13, (28-37E), near Midnite mine. **Owner:** Dahl Uranium Mine, Inc., Spokane, Wash. (1955—). **Ore:** Uranium. **Deposit:** Autunite near contact of granite with argillite. **Dev:** Several drill holes as much as 75 ft. deep showed weak radioactivity. One hole showed ore from the 128-ft. to 140-ft. depth. **Assays:** 0.20% to 0.70% U_3O_8 equivalent from 128-ft. to 134-ft. depth in one hole. **Ref:** 158.

Germania (8)

(see under tungsten)

Germania Consolidated (8A)

(see under tungsten)

Indian Chief Uranium (Crawford) (7)

Loc: Sec. 10, (29-37E) and N $\frac{1}{2}$ sec. 8, (29-38E), about 7 mi. N. of Midnite mine. **Access:** Roads. **Prop:** 22 unpatented claims. **Owner:** Indian Chief Uranium Co. leasing to Sidney Mining Co. and Mascot Mines Co., Kellogg, Idaho (1955—). **Ore:** Uranium. **Deposit:** Autunite reported in sec. 10, (29-37E) in a "tight" vein at a granite-quartzite contact. Exposed along the full length of a 30-ft. bulldozer trench that does not reach either end of the vein. **Dev:** 1,800 ft. of bulldozer trenching (May 1955). **Ref:** 158.

Lowley (17)

Loc: S $\frac{1}{2}$ sec. 13, (27-37E), 7 mi. S. of Midnite mine. **Prop:** 320 acres. **Owner:** Daybreak Uranium, Inc., Spokane, Wash., has assignment of prospecting lease held by William Lowley, Wellpinit, Wash. (1955—). **Ore:** Uranium. **Ore min:** Uraninite, uranophane, autunite, and torbernite. **Deposit:** Faulted contact between granite and metasediments has uranium mineralization in small fracture seams throughout an area 100 ft. by 300 ft.

Assays: 50 lb. of samples across 70-ft. width reported to run 1.05% U_3O_8 . **Prod:** 5 carloads reported in 1956. **Ref:** 158.

Lucky Charm Uranium (10)

Loc: Adjoins the Midnite uranium mine on the NE. In sec. 7, (28-38E), also secs. 23 and 26, (27-37E) and S $\frac{1}{2}$ sec. 23, (29-38E). **Owner:** Lucky Charm Uranium Mines, Inc., Spokane, Wash., holds prospecting permits on 5 sections of Spokane Indian Reservation land. **Ore:** Uranium. **Deposit:** "Good radioactivity." Autunite along joints in altered basalt in bulldozer cuts in S $\frac{1}{2}$ sec. 23, (29-38E). **Ref:** 158.

Midnite (9)

Loc: Secs. 1 and 12, (28-37E), on flanks of Lookout Mtn., 10 mi. NW. of Wellpinit. **Elev:** 2,800 to 3,400 ft. **Access:** 33 mi. by road to railroad at Springdale or Reardan. **Prop:** 570-acre lease from Spokane Indian Agency. **Owner:** Midnite Mines, Inc., Clair Wynecoop, Pres., Wellpinit, Wash. (1954—) leasing to Dawn Mining Co., 503 Public Service Bldg., Portland, Ore. (1955—). **Ore:** Uranium. **Ore min:** Autunite, uranophane, gummite, torbernite, uraninite, liebigite, phosphuranylite. **Gangue:** Altered rock. **Deposit:** Radioactivity traced more than 1 mi. N. and S. Uranium mineralization is in shear zones at and near intrusive contact of Loon Lake granite and Deer Trail argillite in a contact zone which is 100 to 200 ft. wide. Ore bodies, ranging up to several hundred ft. in length and 30 or more ft. in width, are richest at the center and grade outward to assay walls. Autunite and uranophane are the principal ore minerals, but uraninite was found with pyrite at a depth of 150 ft. in one core hole. Mineralization is strongest along joints in argillite but extends down into granite also. Est. 700,000 tons ore reserves reported in 1956. **Dev:** 13 diamond drill holes drilled by A.E.C. and 28,476 ft. of diamond drill holes drilled by Dawn Mining Co. Numerous bulldozer trenches, 540 ft. of adit workings (1955). **Assays:** One representative sample ran 0.48% U_3O_8 , and others ran as high as 0.86% U_3O_8 . Av. of 709 tons shipped was 0.285% U_3O_8 . **Prod:** 100 tons of ore in 1954, 609 tons through Feb. 1955. 94 carloads of ore prior to end of Jan. 1956. **Ref:** 152-A. 158.

Northwest Uranium (15)

Loc: On Spokane Indian Reservation, southern Stevens County, 3 mi. S. of Midnite mine. **Owner:** Northwest Uranium Mines, Inc., Wallace, Idaho (1955—). **Ore:** Uranium. **Ore min:** Autunite. **Deposit:** Secondary uranium minerals in faults and lignite beds in flat-lying Tertiary claystone, sandstone, and conglomerate beds overlying granite. **Dev:** Trenches in an area 1,000 ft. by 600 ft. **Assays:** Sample across 20-ft. stratigraphic thickness of beds shows 0.13% U_3O_8 . Selected samples from lignite show as high as 1.15% U_3O_8 and av. 0.643%. A fault-breccia zone 3 ft. wide assays 0.237% U_3O_8 . Chemical analysis of three 50-lb. samples showed: (1) bentonitic clay and carbonaceous material—0.427% U_3O_8 , (2) arkose—7.16% U_3O_8 , (3) conglomerate—0.128% U_3O_8 . Radiometric analysis of these same samples showed only about half the above indicated values. **Ref:** 158.

O'Toole Mountain (3)

Loc: N $\frac{1}{2}$ sec. 9, (38-39E), on O'Toole Mtn., 12 mi. from Bossburg. **Elev:** 3,500 ft. **Access:** Road. **Prop:** 2 claims: Mountain View No. 1, Urabar No. 1. **Owner:** V. J. Granfors, Seattle, Wash. (1953). Grutts and Mulligan (1903). **Ore:** Uranium reported, but one spectrographic analysis failed to show any uranium although the sample was radioactive. The rare earth elements, scandium, yttrium, and ytterbium are present. **Ore min:** Pyrite, galena. **Ref:** 105, 2/03, p. 95.

Painted Desert (2A)

(see also under Spokane County)

Loc: Near Orient. **Prop:** 6 claims and options on 195 acres of land. **Owner:** Painted Desert Uranium and Oil Co., Spokane,

Wash. (1955—). **Ore:** Uranium. **Assays:** Samples reported from 0.30% to 1% U_3O_8 . **Ref:** 158.

Railway Dike (see Cannon)

Section 13 (16)

Loc: Sec. 13, (27-37E), in Spokane Indian Reservation. **Ore:** Uranium. **Deposit:** Uranophane in anthophyllite along contact. **Ref:** 158.

Snowshoe (6)

Loc: Secs. 33 and 34, (30-38E). **Prop:** 10 unpatented claims. **Owner:** American Silver Mining Co., Spokane, Wash., and Frontier Uranium, Inc., Seattle, Wash., jointly own the property (1955). **Ore:** Uranium (?). **Deposit:** Radioactivity reported. **Ref:** 158.

Square Deal (13)

Loc: Sec. 13, (28-37E), adjacent to Midnite property. **Owner:** Square Deal Mining & Milling Co., Wallace, Idaho, has agreement with Spokane Indian tribal members who hold prospecting permits on 640 acres (1955). **Ore:** Uranium. **Deposit:** U_3O_8 values of about 0.1% along granite-argillite contact. **Ref:** 158.

U & W Uranium (2)

Loc: Leased land in Secs. 13, 14, 23, 24, 25, and 26, (40-36E), Orient dist. **Access:** Road. **Prop:** Several hundred acres of

leased land, 11 unpatented adjacent claims. **Owner:** U & W Uranium, Inc., Spokane, Wash., is leasing mineral rights from J. C. B. Graeber and others (1955). **Ore:** Uranium. **Deposit:** Uraninite in mica schist. **Assays:** One sample from center SE $\frac{1}{4}$ sec. 23, (40-36E) is reported to show 2.82% U_3O_8 . **Ref:** 158.

YAKIMA COUNTY

Bumping Lake (1)

Loc: In the valley of Deep Cr., near the mouth of Copper Cr., on the road to Copper City, 5 mi. S. of Bumping Lk. dam. **Access:** 5 mi. by gravel road and 11 mi. by paved road from Chinook Pass highway. 53 mi. by road from railroad at Naches. **Prop:** 6 unpatented claims, including El Khohbar No. 1. **Owner:** Tom Hendrix, Yakima, Wash. (1954—). **Ore:** Uranium. **Deposit:** Strong radioactivity in soil and gravel around a mineral spring which emerges from granite near contact with andesite. Also some autunite along joints in granite. **Dev:** Open pits. **Assays:** 0.88% U_3O_8 by wet analysis and 0.36% U_3O_8 by radiometric test on surficial soil. **Note:** Within a few days of the announcement of this original discovery more than 80 claims were staked by various people in an area about 2½ mi. square in this vicinity. **Ref:** 158.

Chinook Pass (2)

Loc: About 3 mi. E. of Chinook Pass, in western Yakima County. **Owner:** Thomas Smith, Hainline, Wash. (1955—). **Ore:** Uranium reported. **Ref:** 158.

VANADIUM

Properties—Vanadium is a brilliant silver-white metal that is soft, corrosion resistant, and malleable and ductile enough to be drawn into wire. It is not affected by air or water at ordinary temperatures. Chemically it may be either acid or base forming. Its valences are 2, 3, 4, and 5, the last being the most stable. Other properties are shown in the table on page 12.

Uses—In 1950 about 90 percent of the vanadium consumption was as ferrovanadium, which was used in the manufacture of tool steels, other special steels, and in wear-resisting cast irons. Small amounts of ferrovanadium were used in welding-rod coatings, in magnets, and as a deoxidizer. In the same year ductile vanadium, 99.8 percent pure, was made available, but no commercial use has yet been made of the unalloyed metal, except as targets in X-ray apparatus. A few nonferrous alloys have been developed, the most important of which are of vanadium with copper and with aluminum. Both of these alloys are strong and corrosion resistant. Very small additions (0.1 to 0.2 percent) of vanadium to steel bring about great increases in strength, elastic limit, hardness, and shock resistance. Vanadium chemicals have some uses as catalysts in making sulfuric acid and various organic compounds, and other vanadium compounds are used in glass, ceramic glazes, as driers in paints and inks, and in laboratory research.

Production—United States production of vanadium in ores and concentrates dropped from over 5½ million pounds in 1943 to a little more than 2 million pounds in 1947, and since that date production figures have been restricted for security reasons. The few principal United States consumers of vanadium have their own sources of ore, and it would be difficult for an outsider to bring

a new deposit into profitable operation. Vanadium minerals have been reported in seven counties in Washington, but only the occurrences in Skamania County have been verified, and none of these has had any production.

Prices—The quoted price for V_2O_5 contained in vanadium ores remained at 27½ cents per pound f.o.b. mines for a period of 26 years, from early 1925 to early 1951; thereafter the quotation was raised to 31 cents per pound, where it remained at least through most of 1955. Although the price of contained vanadium in ferrovanadium alloy has fluctuated somewhat, it also has had a remarkably small long-range variation, selling at \$3.15 to \$3.50 in 1930 and \$3.00 to \$3.20 in 1953.

Ore minerals—Vanadium is widely spread in minute quantities, occurring in most rocks in amounts varying between a trace and a few hundredths of 1 percent. Some petroleum and many coals contain very small percentages of the element, and the oxide may be recovered from the ashes of these organic materials. Vanadium occurs in more than 60 minerals, but only 5 of these are primary. The minerals of principal economic interest are the sulfide, patronite, VS_4 , containing 19.5 percent vanadium; the vanadium mica, roscoelite, $H_xK(Mg,Fe)(Al,V)_4(SiO_3)_{12}$, containing from 20 to 29 percent V_2O_5 ; and the vanadates, vanadinite, $3Pb_3V_2O_8 \cdot PbCl_2$, containing 19.4 percent V_2O_5 , descloizite, $4(Pb,Zn)O \cdot V_2O_5 \cdot H_2O$, and carnotite, $K_2O \cdot 2UO_3 \cdot V_2O_5 \cdot 3H_2O$, containing about 20 percent V_2O_5 .

Geology—Vanadium has been recovered commercially from phosphate rock, iron ore, chrome ore, magnetite beach sands, bauxite, petroleum and coal ashes, and asphaltite. In addition, many lead, zinc, and copper deposits contain a little vanadium, and, especially in dry regions

where the soluble salts are not carried away immediately in solution, it concentrates in the oxidized parts of the veins as vanadinite, descloizite, and related minerals. The world's largest known reserves are in the form of patronite in asphaltite in Peru, but in the United States the largest reserves are in small irregular deposits in soft

fine-grained sandstone, between the grains of which are roscoelite, carnotite, and similar vanadium minerals. These deposits are in an extensive area in western and south-western Colorado and portions of the adjoining states. The only authenticated vanadium occurrences in Washington are in the oxidized zone of copper deposits.

OCCURRENCES

The map showing the numbered vanadium occurrences is plate 23, on page 59 in volume 2.

CHELAN COUNTY

Dryden

Loc: 12 to 15 mi. from Dryden. **Ore:** Vanadium. **Deposit:** This unverified report is of doubtful authenticity. **Ref:** 40, p. 37.

CLARK COUNTY

Sunset Falls (1)

Loc: Vicinity of Sunset Falls C. C. C. Camp in SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 24, (4-4E). **Access:** Road. **Ore:** Reportedly vanadium. Very doubtful. **Deposit:** Country rock of andesite, agglomerate, and flow breccia. **Ref:** 158.

KITTITAS COUNTY

Big Z

(see Zerwekh under gold)

Zerwekh (1)

(see under gold)

SKAGIT COUNTY

Scott (1)

Loc: 9 mi. N. of Hamilton. **Prop:** 5 claims. **Owner:** Scott Bros. (1936). **Ore:** Vanadium. Doubtful occurrence. **Ref:** 158.

SKAMANIA COUNTY

Last Chance (2)

(see under copper)

Rainbow (3)

Loc: Center S $\frac{1}{2}$ S $\frac{1}{2}$ sec. 32, (3-5E), on ridge separating the W. Fk. of Washougal R. from Wild Boy Cr. **Access:** 14 mi. by road from Cape Horn. **Owner:** Owned by Fred Wark and optioned by John Hogg, Vancouver, Wash. (1942). **Ore:** Re-

portedly vanadium, lead, copper, gold, silver, uranium. Presence of uranium is very doubtful. **Gangue:** Quartz, some amethystine. **Deposit:** Quartz vein with yellow phosphate mineral along cracks. **Dev:** 2 shafts. **Assays:** As much as 5% vanadium reported. **Ref:** 58, p. 56. 104, vol. 14, no. 4, p. 40. 158.

Skamania (1)

(see under copper)

SNOHOMISH COUNTY

Clara Thompson

(see Jasperson under gold)

Commonwealth

(see Jasperson under gold)

Good Hope (2)

(see under gold)

Index

Loc: Index dist. **Owner:** C. S. Armstrong. **Ore:** Vanadium. **Assays:** 98% "vanadium" reported. Doubtful. **Ref:** 14, p. 19. 40, p. 37.

Jasperson (3)

(see under gold)

McCombs

(see Jasperson under gold)

Wayside (1)

(see under copper)

Webster

(see Jasperson under gold)

WHATCOM COUNTY

Smith (1)

Loc: Sec. 23, (40-4E). **Prop:** 80 acres. **Owner:** Lowell F. Smith, Sumas, Wash. (1936). **Ore:** Vanadium reported. Doubtful. **Ref:** 158.

ZINC

Properties—Zinc is a bluish-white lustrous metal that is easily fusible and fairly hard. It is brittle at ordinary temperatures, but when annealed it becomes ductile and malleable and does not become brittle upon cooling, but when reheated to 200° it is again brittle. It is a fair conductor of heat and electricity. Zinc is only moderately resistant to corrosion, but it is better than iron in this respect, and because of this and the very great affinity that zinc and iron have for each other, it is used to coat and protect iron from atmospheric corrosion. The electrochemical properties of zinc account for its use in batteries, and its chemical properties for its use in photoengraver's sheets. Zinc is bivalent in all its compounds. Other properties are shown in the table on page 12.

Uses—The galvanizing industry has long been the largest consumer of zinc, accounting for more than 45 percent of the 1950 consumption. Galvanizing is the placing of a thin coating of zinc, usually on iron or steel sheet, wire, tubes, pipe, fittings, and other shapes. Zinc-base alloys for die castings used nearly 30 percent of the available zinc in 1950, followed by brass (14 percent) for sheet, strip, plate, rod, wire, tubes, castings, and other copper-base products. Rolled zinc accounted for about 7 percent of the consumption; zinc oxide, 2 percent; and 1 percent, for other uses such as wet batteries, desilvering of lead, in light-metal alloys, and chemicals. Zinc oxide and other chemicals are used as pigments, as a filler in rubber, in glass manufacture, in medicines, and in many other minor uses.